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This Week

The major automobile manufacturers in the Detroit area are doing their utmost in the development of designers and engineers for the years to come. What they are doing and how they do it makes an interesting story which begins on page 900.

Across the editor's desk has come some enlightening correspondence. Some of these letters are printed on pages 904 and 905.

A rather wide range of subjects is covered in the abstracts of some of the important papers presented at the S.A.E. Summer Meeting. Just turn to page 906.

More Space for Buick

Expansion to Include Five Buildings and Cost $1,500,000

Another expansion program involving five construction projects costing $1,500,000 and adding 400,000 sq. ft. of floor space is announced by Buick Motor Co. Ground is to be broken at once for the first unit and it is expected the entire building program will be under way within 30 days with contracts calling for speedy completion.

Not long ago, Buick completed a $15,000,000 factory rehabilitation and expansion program in preparation for production of 1936 models. These facilities have been taxed to the limit and with the success of the 1936 models need for greater capacity has become urgent. The new construction, which will substantially redesign the company's manufacturing layout, will result in an increased assembly capacity needed to meet the steadily increasing volume of Buick business.

This progress is demonstrated in the company's steady growth of sales for the years from 1933 to date. In 1933, Buick sales were 43,000, in 1934 they were 65,000, and in 1935 they jumped to 107,000. A conservative estimate for 1936 places sales for this year at 170,000.

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Car Shortage Predicted

Sustained Demand May Soon Exhaust Current Models, Leaving Gap Until '37 Lines Appear

By Harold E. Gronseth

The way automobile sales are holding up into the summer, manufacturers are beginning to wonder if they have not set their production goals for current models too low. Some already are predicting a car shortage before new models reach the market. Having made material commitments for the balance of the 1936 run, the elasticity to a great extent has been taken out of schedules. So long as demand remains strong, output will be maintained at high levels but any increase in the production rate this month or next must be taken out of the remaining weeks of the 1936 manufacturing program, since limits definitely have been fixed.

The traditional clean-up problem before new model announcement will not be present this year. Indications are that many plants will complete their rush on current models ahead of schedule. Unless they are able to advance their announcement dates on 1937 cars, which is something not easily done, the interval between old and new models will be somewhat longer than expected. Such a situation will be welcomed by many dealers as it will give them more time to concentrate on the liquidation of used car stocks, bringing them into line before the surge of new model buying sweeps in another flood of used vehicles.

Factories report that used car stocks are coming down at a good rate. Reductions are general all along the line. One large dealer organization established a new high for sales last week. Less than a month's supply of new cars are in the field on basis of current rate of deliveries. The industry entered May with a scant 400,000 passenger cars in dealers' hands and reduced this inventory by more than 26,000 cars during the month, leaving some 373,000 in the field when June began, and there has been further reduction this month.

Retail deliveries are maintaining practically the same pace as in May. Six companies reporting for the second 10 days of June were off just 1000 cars from their volume for corresponding period last month. Several companies are doing better than they did in May. Bonus business has been slow in materializing, probably because of the time

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Tire Prices to Jump?

Original Equipment May Cost 10% More After July 1, Akron Hears

Original equipment tire prices to automobile manufacturers will be advanced approximately 10 per cent on July 1 by the four major tire manufacturers who supply this market, according to reliable reports current in tire industry circles. These companies are Goodyear, Goodrich and Firestone in Akron, and the United States Rubber Co. of Detroit. It will be the first increase in original equipment prices in more than a year. While prices in this sector of the tire market were raised

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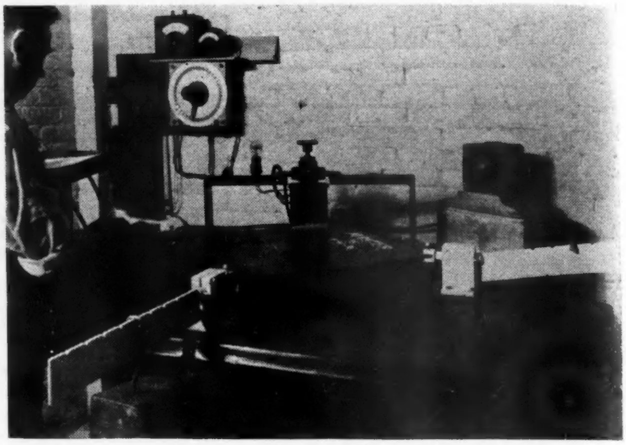
1935 Gasoline Consumption Up 6.4 Per Cent Over 1934

Gasoline consumption for highway use in the United States totaled 16,264,961,000 gals. in 1935, according to the most recent estimates of the Bureau of Public Roads, Department of Agriculture. This represents an increase of 6.4 per cent over the previous years, and the bureau reports that the figure includes some gas sold for non-highway use in the 13 States which do not allow refunds for this purpose.

Total State revenue receipts amounted to $619,677,466, a figure which is not directly comparable with the previous year owing to a change in the refund policies. The average State tax rate amounted to 3.8 cents per gal.

Lincoln's Sound Tests

Apparatus Measures Noise-Deadening Qualities of Materials



Apparatus for testing sound-deadening materials at the Lincoln Motor Co.'s plant

An apparatus for testing sound-deadening materials has been developed by the engineers of the Lincoln Motor Co. and is shown in the accompanying photograph. It is set up in a solid brick vault with double steel doors in the basement of the Lincoln plant. The testing unit is mounted on a steel-top table which has a heavy cast-iron frame. It has four brackets for supporting the test panels, two of these having movable jaws attached to lever arms, making it possible to vary the tension applied to the panel by moving the weights on the lever arms. Test panels are clamped in position in the jaws by means of set screws. At one corner above the test panel there is a powerful electromagnet used to vibrate the test panel. It is energized by impulses furnished by a special non-arcing generator of Lincoln design which can furnish impulses at rates up to 4000 per minute.

In making a test, first the jaws with the weight arms are loosened and the test panel is vibrated for a short time by electrical impulses to straighten out any minor kinks or waves in it. Then it is locked in position and again vibrated at various rates until a noise meter shows the maximum noise. The electromagnet is then turned off, a rubber ball is dropped on the center of the panel from a fixed height, and the indication of the audio meter is noted. Then the ball is again dropped from this same fixed height and a "decay" reading is taken. This gives the time interval for the resonance to decrease in intensity until it passes out of the audible range. After these data are obtained, various sound-deadening materials are applied to the test panels and the test procedure is repeated. A comparison of the readings indicates the relative value of various samples of sound-deadening material.

July 6 Deadline for Filing of N.Y. Show Space Applications

Official invitations to exhibit at the National Automobile Show which will be held at the Grand Central Palace, New York, Nov. 11 to 18, were mailed last week to all eligible manufacturers of motor vehicles, parts, accessories and automotive shop equipment. In order to participate in the first drawing for show space, companies desirous of exhibiting products at the show must have their applications filed with the association not later than July 6.

European Notes

It is reported that the Graf & Stift Co., a pioneer of the Austrian automobile industry which owns a factory of considerable size not far from Vienna, is conducting negotiations with Ford for the production of Ford cars in its plant. For the present it is contemplated only to assemble in the Austrian plant, the parts being furnished by one of the Ford European plants.

* * *

During the first quarter of the current year 42,643 private automobiles were sold in Germany, as compared with 36,847 during the same period last year, an increase of 16 per cent. Car registrations for the first quarter also showed an increase in France, for the first time in several years. In that country 40,368 cars were registered, as compared with 32,575 last year.

* * *

An English contemporary reports that it is possible to get Diesel engines installed in gasoline vehicles for about £180 in that country. The engine is the Wolf four-cylinder engine made by F. Perkins, Ltd., of Peterborough. It has a 3.34-in. bore and 4.75-in. stroke. Mounted in a Studebaker Dictator sedan, this engine is said to give a fuel mileage of over 29 per imperial gallon, as compared with 17 for gasoline.

Mexico imported 14,357 passenger automobiles, mostly from the United States, last year.

Heavy Gain in Retail Financing

April Totals Show 53 Per Cent Increase Over Year Ago; Wholesale and Retail Figures Well Above March

While wholesale financing in April, totaling $194,523,329, showed a gain of 19 per cent over the corresponding month in 1935, retail financing for the month showed a gain of 53 per cent over the previous year, and amounted to $180,926,890, according to estimates of the Bureau of Census, Department of Commerce. Wholesale financing for the first four months showed a gain of 15 per cent over the previous year and the retail figure climbed 49 per cent for the same period.

The average amount per car in all classifications increased from $370 per car in April, 1935, to $405 in April, 1936, while the amount per new car increased from $538 to $573.

The increase over the March figures showed steady gains of 20 per cent in retail and 23 per cent in the wholesale field. The accompanying table gives the complete comparative figures according to the various classifications.

	Wholesale Financing Volume in Dollars	RETAIL FINANCING											
		TOTAL			NEW CARS			USED CARS			UNCLASSIFIED		
		Number of Cars	Total Amount	Per Car	Number of Cars	Total Amount	Per Car	Number of Cars	Total Amount	Per Car	Number of Cars	Total Amount	Per Car
April 1936........	$194,523,329	446,956	$180,926,890	$405	209,307	$119,894,021	$573	234,766	$60,052,639	$256	2,883	$980,230	$340
March 1936.......	158,555,634	378,230	150,820,930	399	172,388	97,778,634	567	203,523	52,235,748	257	2,319	806,548	34
April 1935........	163,235,442	320,855	118,663,435	370	140,478	75,622,340	538	174,775	41,002,364	235	5,602	2,038,731	364
4 Months 1936....	593,208,837	1,299,736	516,734,576	398	583,818	332,910,511	570	707,735	181,034,457	256	8,183	2,789,608	34
4 Months 1935....	517,008,914	937,614	347,719,362	371	411,615	221,181,831	537	508,089	120,027,554	236	17,910	6,509,977	36

New Models Appear in Europe

Both Morris and Wolseley in England Announce New Types; Fiat to Produce Baby Car in Italy

Special to AUTOMOTIVE INDUSTRIES

For the third year in succession Morris has introduced an entirely new model in the middle of the season. The new car has an L-head six cylinder engine of 111 cu. in. displacement, with a wheelbase of 106 in. and a 56-in. track. It has two types of five-passenger four-door sedan body, one with fixed roof and the other with a sliding roof, the latter being termed the de luxe version. Prices are, respectively, £215 and £225.

There is nothing unorthodox in the chassis design relative to Morris practice of late. The frame is of box section, with a pressed steel plate forming a central stiffening member and serving as the base of the front and rear floors. The steel body is built up on box section foundation members, which are bolted to the chassis at over 30 points, thus serving to stiffen the latter.

On June 26 a new Wolseley model was announced, supplementing the range of three sixes (16 hp., 21 hp. and 25 hp.), introduced at the Olympia show last October, and the two fours, 10 hp. and 12 hp., put forward earlier this year.

The new model is an overhead-valve six of 14 hp. rating, and is to be known as the 14-56 hp. type. It corresponds in general with the new Morris announced on June 9, and its conception carries further the policy of Lord Nuffield whereby his Morris and Wolseley plants produce respectively a "popular" and a "de luxe" series of cars of the same basic types but with differences of detail placing them in different price classes. Thus, while the new Morris Fourteen-Six, has three speeds, side valves, a single carbureter and 5.25 in. tires, the new Wolseley has four speeds, overhead valves, two carburetors and 6 in. tires, besides additional equipment such as two fog lamps (serving also as non-glare passing lights), extractor type hinged rear-quarter windows, and a five-passenger sedan body of higher grade in constructional details, upholstery and equipment. There is a difference of £40 between the two cars, the Morris being £215 or (with what is termed de luxe equipment) £225, and the Wolseley £265.

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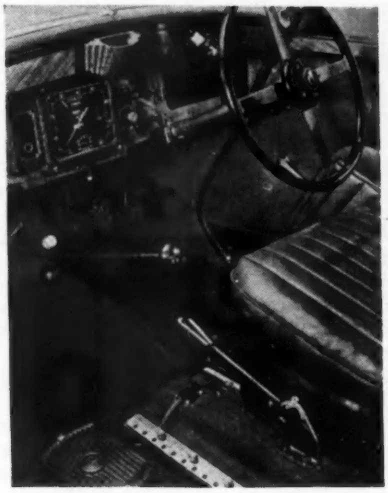
The Adler-Trumpf car which recently made six new international records

European photo



Driving compartment of the new British Morris

Speed

A series of new international records, Class E, made by the Adler-Trumpf, has just been recognized by the Association Internationale des Automobile-Clubs Reconnus. Class E covers cars having engines of from 1100 to 1500 cu. cm. piston displacement.

The Adler-Trumpf made the record runs on the new automobile road from Frankfurt-am-Mein to Virnheim. It was equipped with a four cylinder engine having a bore of 75 mm. (2.95 in.) and a stroke of 95 mm. (3.74 in.). The displacement was 1678.7 cu. cm. (102 cu. in.). Drivers were: Löhr, v. Guillaume, Heckel, Graf, Orsich and Sauerwein.

The records established were as follows:

2000 kilometers in 12 h., 30 min., 40 sec., 47/100 at an average speed of 159.856 km. p. h. (99.33 m. p. h.).

2000 miles in 19 h., 55 min., 18 sec., 60/100 at an average speed of 161.565 km. p. h. (100.39 m. p. h.).

3000 kilometers in 18 h., 35 min., 25 sec., 40/100 at an average speed of 161.374 km. p. h. (100.27 m. p. h.).

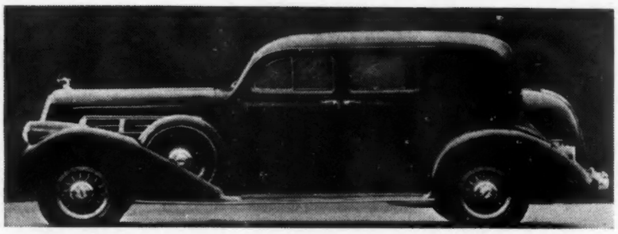
4000 kilometers in 24 h., 56 min., 28 sec. at an average speed of 160.378 km. p. h. (99.65 m. p. h.).

In 12 hours, 1913.812 kilometers were run at an average speed of 159.484 km. p. h. (99.10 m. p. h.).

In 24 hours, 3854.356 kilometers were covered at an average speed of 160.598 km. p. h. (99.79 m. p. h.).

Ben V. Borella

Ben V. Borella, assistant general treasurer of General Motors Corp., died of a heart attack in his New York office on Monday, June 22. Mr. Borella, who was 45, was graduated from Dartmouth College in 1915 and joined the General Motors financial staff in 1923. He was appointed assistant treasurer of the corporation in 1929.



Pierce Arrow's new formal sedan, is furnished on the DeLuxe 8 and the Salon 12 chassis. An adjustable glass partition separating the driver's compartment may be lowered into a well behind the driver's seat.

Wisconsin to Discuss Dealer Licensing Law

Notice has been given by the Wisconsin State Banking Committee of a public heating to be held in Milwaukee on July 28 for the purpose of discussing proposed methods of strengthening the dealer licensing law. Much importance is attached to the scheduled discussion of rules regarding the selling by dealers of automobiles other than those for which such dealers are licensed. Bootlegging is expected to be attacked on a broad front.

Rules for the prevention of unethical selling and advertising methods and provisions affecting the transfer of salesmen's licenses will be discussed, in addition to a complete investigation into financing practices. A breakdown of charges by dealers and finance companies may be made mandatory under certain conditions.

Prices of Ford DeLuxe Models Raised $20, Accessories Added

Ford Motor Co. has increased the price of its deluxe models by approximately $20 due to the inclusion of several accessories as standard equipment which heretofore were optional. The items added to the deluxe accessories group are flexible steering wheel, glove compartment lock, and rear view mirror with 30-hour clock installed.

Improvements have been made in the interior of standard models without change in price. These include mahogany grain instrument panel instead of plain, and the offering of mohair upholstery as optional. Deluxe models are now finished with walnut grain instrument panels.

Kelsan Products Taken Over by Frank Saunders

The business of Kelsan Products, St. Clair, Mich., manufacturers of liquid rubber products, formerly conducted by P. E. Kelley and Frank M. Saunders, has been taken over by Mr. Saunders who will conduct it in the future. Mr. Kelley has retired and will engage in business for himself.

Fulton Celebrates "25th" As Accessory Producers

The Fulton Co., Milwaukee, celebrates this year its 25th anniversary in the automotive accessory field. Samuel A. Fulton, its president, organized the business in 1911, and points with pride at the accessory ideas introduced by his company which have been adopted as standard by all car manufacturers.

In the honor of the anniversary event a booklet containing a brief history of the company and interesting views of its current activities is being distributed by the company.

Trademarks Registered

BELL TRAILER, by John V. Morse, doing business as Bell Trailer Co., Chicago.

MONOSTEEL, by the Briggs Manufacturing Co., Detroit.

GREAT DANE, by the Steel Products Co., Inc., Savannah, Ga. (For Trailers.)

SILVER MOON, by William H. Redman, doing business as Alma Trailer Co., Alma, Mich. (For trailers.)

Tire Prices to Jump

(Continued from page 889)

early last year, due to competitive conditions the advance was not uniformly enforced.

Tire manufacturers cite the fact that an advance in original equipment prices long has been an economic necessity. They claim that due to steadily rising raw material costs and the increased labor and production costs encountered by Akron firms since early spring due to continued labor strife and frequent sit-down strikes of union tire builders, manufacturers have scarcely been recovering bare costs from the original equipment business, and in many instances have taken this business at an actual loss.

Original equipment prices were not advanced last May 4 when the tire industry put into effect a blanket increase in consumer tire prices, which averaged approximately 11 per cent. The increased recovery accruing to manufacturers in the Akron area from the May retail price advance, was practically offset by the 10 per cent wage increase which they gave to more than 40,000 employees on May 5 in an effort to relieve the labor tension.

Crude rubber costs have been climbing steadily since the first of the year, with crude rubber now quoted at between 15 and 16 cents a pound. It is an established fact that practically all manufacturers have worked off their inventories of low-priced rubber, and rubber going into current production is priced higher than for several years.

Original equipment tire deliveries for the first half of 1936 will exceed 12,000,000 units according to industry estimates, and it is figured that original equipment deliveries for the entire year will exceed 21,000,000 units. Last year original equipment deliveries in the first six months were less than 10,-

Production Well Over Year Ago

Trucks Still Show Larger Gains in May and Five Months Totals; Only Small Seasonal Drop from April

Passenger car and truck production for the United States and Canada during May totaled 480,571 units, running approximately 21 per cent above the 1935 figure for the same month, according to figures of the Bureau of the Census, Department of Commerce. The seasonal decline from the preceding month was approximately 9 per cent, and for the first five months of 1936 production totaled 8 per cent higher than the same period of 1935.

Truck production, totaling 78,675 units, showed an even greater increase being 33 per cent ahead of last year. For the first five months, the truck total was 17 per cent ahead of 1935.

Canadian production was slightly below last year for May and for the first five months, while U. S. production for export showed corresponding increases for both periods.

Passenger Car and Truck Production—U. S. and Canada

	May, 1936	April, 1936	May, 1935	First Five Months 1936	First Five Months 1935
Passenger Cars—U. S. and Canada:					
Domestic Market—U. S.	365,457	395,182	285,676	1,569,526	1,456,738
Foreign Market—U. S.	20,050	21,951	19,871	99,727	96,507
Canada	16,389	20,247	17,030	73,238	78,051
Total	401,896	427,380	322,577	1,742,491	1,631,296
Trucks—U. S. and Canada:					
Domestic Market—U. S.	63,321	74,363	45,513	309,017	260,969
Foreign market—U. S.	11,737	11,279	10,047	57,651	47,701
Canada	3,617	4,704	3,672	16,263	17,470
Total	78,675	90,346	59,232	382,931	326,140
Total—Domestic Market—U. S.	428,778	469,545	331,189	1,878,543	1,717,707
Total—Foreign Market—U. S.	31,787	33,230	29,918	157,378	144,208
Total—Canada	20,006	24,951	20,702	89,501	95,521
Total Cars and Trucks—U. S. and Canada	480,571	527,726	381,809	2,125,422	1,957,436

500,000 and for the entire year were just slightly above 19,000,000.

Due to the fact that inventories were depleted during the six weeks' Goodyear strike, and also to the continued heavy original equipment demand and the sharp increase in consumer demand since May 1, practically all tire manufacturers are pushing their plants to the limit. In the Akron area daily output is exceeding 110,000 units, with all plants running at full blast when not interrupted by sit-down strikes. Akron manufacturers are continuing to push their decentralization plans due to the acute labor situation. Goodyear, in addition to large warehouse facilities just leased in Detroit, has materially increased output at its subsidiary plants in Gadsden, Ala., Cumberland, Md., and Los Angeles, and in these plants, with Akron, now has a capacity exceeding 70,000 units per day. Both Goodrich and Firestone are reported to have transferred considerable tire building equipment from Akron to their Pacific Coast subsidiaries.

General Tire & Rubber Co., which some time ago announced it would establish a mechanical goods and tire factory outside of Akron because of the labor situation, has notified stockholders of a special meeting July 16 to ratify a proposed revision of the company's capital structure. It is proposed to reduce the par value of common stock from $25 to $5 per share and to increase the number of authorized shares from 100,000 to 500,000. The company has 13,000 shares unissued and the new program would increase this treasury stock to 65,000 shares. It is reported in Akron that the move is the first step in the company's expansion program. General makes no original equipment tires.

Union to Join AFL

Largest Independent Automotive Group Votes for Merger

The 26 locals of the Automotive Industrial Workers Association, largest of the independent unions in the motor industry, voted to amalgamate with the United Automobile Workers, International Union of the A. F. of L., and will be absorbed by the latter organization July 1. Less than 40 dissenting votes were cast, although several of the locals had cast secret ballots. All locals have applied for charters which are now being issued. Officials estimate the merger gives the U.A.W. an additional 26,000 members.

The A.I.W.A. membership voted to place their president, Richard Frankensteen, in the position on the general executive board of the U.A.W. left open to give representation to independent unions that might come in. The old Associated Automobile Workers of America at the Hudson plant and the three former locals of the Mechanics Educational Society, already chartered by the U.A.W. are expected to hold elections for this purpose within the next three weeks.

Merlin D. Bishop of the extension staff of the Brookwood Labor College, Katonah, N. Y., has been appointed educational director of the U.A.W., and the educational program of the union which is to be put into operation this fall will be set up immediately. Bishop, once a Ford worker and graduate of Brookwood and the Wisconsin University Summer School for Teachers in Workers Education, has been assistant supervisor of the F.E.R.A. workers education program in Michigan. His employment by the automobile workers has been worked out on a cooperative arrangement with Brookwood.

As result of the action, taken at the recent South Bend convention of the U.A.W., accepting an offer by Tucker P. Smith, director of Brookwood Labor College, six members of the union will be given scholarships providing for eight months intensive study at the school to prepare them for more effective organization work. Applications for scholarships will be received at union headquarters up to Sept. 1.

New British Rules on Car Design

Proposed Regulations Affect Braking Systems, Rear Overhang, Mascots and Tire Sections

The British Minister of Transport has issued in draft form for criticism and comment by road users' organizations, a new series of regulations affecting chiefly the constructional features of motor vehicles — passenger cars, trucks, buses, tractors, etc. To a large extent this new series consists of revisions of regulations previously in force, but it also comprises new ones, such as a clause giving power to the police to inspect and test the steering and brakes of any kind of motor vehicle, though no official standard of braking efficiency is specified.

Another new regulation insists upon vehicles with brake systems embodying a vacuum or pressure reservoir being fitted with "visible devices warning the driver of any impending failure or deficiency in the vacuum or pressure system." This will apply mainly to air-braking and to the vacuum servo systems with a vacuum reservoir recently adopted for one or two makes of car (Daimler, for example) and for buses.

Among other points in these new regulations are the following:

Rear overhang must not exceed 50 per cent of the wheelbase length.

A plate must be fitted to every wheel of heavy vehicles (trucks and passenger) showing the maximum section of tire for which the wheel is intended, and no tire of greater section must be fitted.

No mascot may be fitted in a position where it is likely to strike any person hit by the vehicle unless the mascot is unlikely to cause injury.

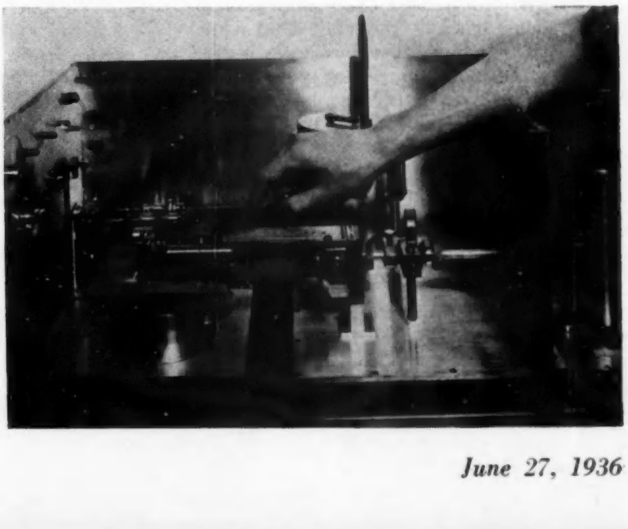
No braking system shall be rendered ineffective if the engine stops.

The maximum axle weight of four-wheeled pneumatic-tired vehicles is raised from 8 to 9 long tons.

All vehicles with a clear space between the front and rear wheels must have a guard rail at each side extending from one wheel to the other.

This last regulation and that regarding mascots and windshield wipers will come into force on Oct. 1 next, but others calling for alteration of design will not apply to existing vehicles until Oct. 1, 1941.

Although the Minister of Transport has been in consultation with the Society of Motor Manufacturers for some while past with a view to devising some minimum standard of visibility at the front, including pillar dimensions, to counteract recent tendencies toward wide pillars and restricted visibility in general, the draft regulations do not touch on this point beyond insisting that: "Every motor vehicle shall be so designed and constructed that the driver can at all times have a full view of the road and traffic ahead."



This illustration shows a profilograph (said to be the third of its kind in the world) installed in the new chemical and metallurgical laboratory of the Ford Motor Co., making greatly magnified records of irregularities in the surface of the Ford V-8 piston pin

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

General business activity last week continued at a high level and remained close to the peak operations for the current movement. Retail sales ranged from 10 to 15 per cent above those a year ago. Merchants anticipate that June sales will compare as favorably with those a year ago as was the case in May. The Board of Governors of the Federal Reserve System announced that business in the first five months of this year was substantially larger than in any corresponding period since 1930.

Carloadings Continue Higher

Railway freight loadings during the week ended June 13 totaled 686,812 cars, which marks a decline of 9033 cars below those in the preceding week, but a gain of 34,701 cars above those a year ago and a rise of 67,931 cars above those two years ago.

Chain Store Sales Better

Sales of 28 store chains, including two mail order houses, during May were 16.4 per cent above those a year ago. During the first five months of this year sales of the same companies were 9.95 per cent above those in the corresponding period last year.

Power Output Gains

Production of electricity by the electric light and power industry in the United States during the week ended June 13 showed a moderate gain above that in the preceding week and was 14.2 per cent above that in the corresponding period last year.

Building Contracts Up 70%

Construction contracts awarded in 37 eastern States during May, according to the F. W. Dodge Corp., amounted to $216,070,700, which marks an increase of 70 per cent above those in the corresponding period last year. Contracts awarded in the first five months of this year were 81 per cent above those in the corresponding period in 1935.

Farm Income Higher

Farm income from the sale of principal farm products during the first four months of this year amounted to $1,899,532,000, as compared with $1,668,144,000 in the corresponding period last year.

Fisher's Index

Professor Fisher's index of wholesale commodity prices for the week ended June 20 stood at 82.5, as against 82.3 the week before and 81.2 two weeks before.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended June 17 showed an increase of $2,000,000 in holdings of discounted bills. Bills bought in the open market and government securities remained unchanged. Money in circulation increased $111,000,000, and the monetary gold stock increased $63,000,000.

New Models Appear in Europe

(Continued from page 891)

The introduction of these mid-season new models recalls the fact that this year British manufacturers have made no agreement, as in recent years, not to announce particulars and prices of complete 1937 programs until mid-August. Any firm is at liberty, therefore, to reproduce the policy adopted by two or three makers in 1931 and 1932, when the full range of the next year's models were made known in June or July. It is unlikely, however, that this will happen again this year, though prior to August other individual new models besides the Morris may be announced.

Fiat is about to market in Italy the small light car of 34.7 cu. in. piston displacement, which was put out in France a few weeks ago. With gasoline costing from $1.10 to $1.25 per gal., by reason of government taxes, it is believed that the present moment is an opportune one for marketing a light two-seater running 65 miles per gal.

There is a marked tendency in Italy toward a decrease in the size of engines. It is known that during the coming year, both Lancia and Alfa Romeo will produce jobs with very much smaller piston displacements than ever before, the sizes being between 67 and 75 cu. in. In Italy, an engine of 91 cu. in. is now looked upon as being in the big car class.

Automotive interests state that there is no shortage of gasoline in Italy and if the price is still maintained at an artifically high level, it is done with the object of assisting the railways. The railroad industry is working on the production of light, high-speed electric rail cars, the electricity for these being obtained from water power. When these are ready, it is expected that the price of gasoline will be dropped, and possibly the horsepower tax will be removed, only the gasoline tax remaining.

Military activities have given an impetus to the automotive industry. For a long time Fiat has run day and night shifts, employing 50,000 hands.

Mexico's New Barter Plan—Rice and Sugar for Trucks

It is expected that American car and truck manufacturers will have less prospect of dealing with the Mexican government on a cash basis since President Lazaro Cardenas sent instructions to all purchasing agents that government equipment was to be obtained, as much as possible, by the barter system. Mexican products such as rice, sugar, salt, alcohol and chick peas are destined to bring vehicles, machinery and tools to Mexico, if the "swapping" plan works out.

40 Years Ago

—with the ancestors of AUTOMOTIVE INDUSTRIES

There seems to be a lack of knowledge among motor experts of the laws governing the speed of vehicles on common roads. Most of them seem to appear to think that they have the right of way and that pedestrians and users of other vehicles must scatter to the four winds before their triumphal march.

So far as speed is concerned, it is true that the lawful limit of speed is continually increasing. Speeds now allowable in cities would have been outrageous violations of law a generation ago. . . .

The whole subject reduces itself to a matter of education. All realize the value of time, but all also realize the value of human life, and the one cannot be ruthlessly sacrificed to the other.

—From *The Horseless Age*, June, 1896.

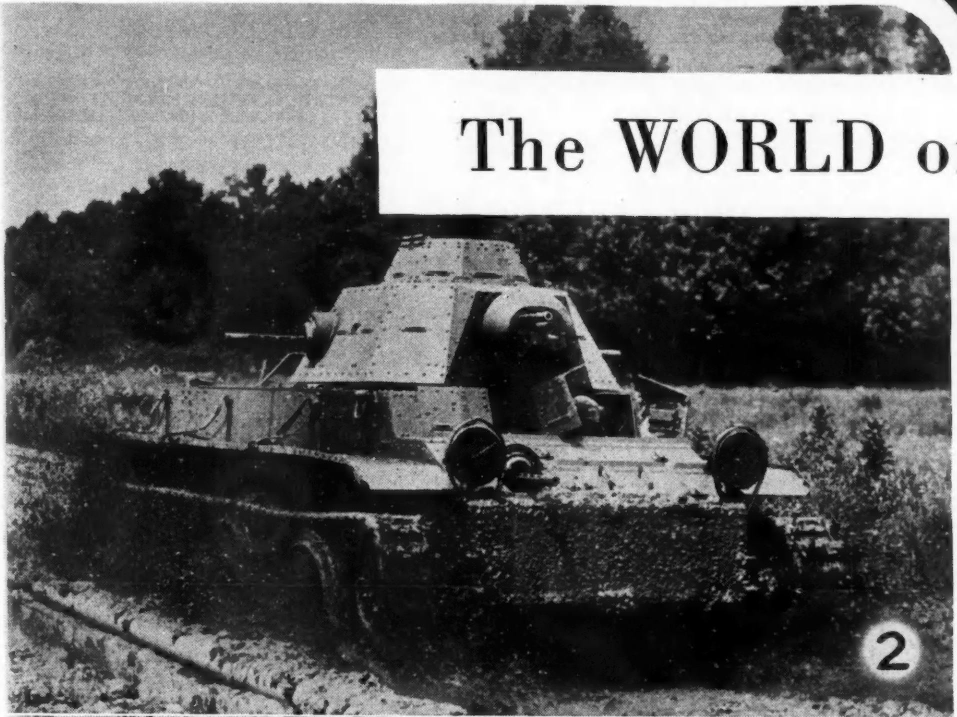
May Sales Now Estimated At 400,000 New Car Units

Based on returns from 33 States, estimates of new passenger car sales for May in the United States have been revised upward for the second time and now stand at 400,000 units, according to R. L. Polk & Co. Only three months in history have sales reached or exceeded the 400,000 mark, and these were all in 1929, during April, May and July.

The estimates for truck sales in the same period stands at 60,000 units

1. At Brentford, England, Great Western Railway truck drivers are being taught to handle the new motor equipment of which this three wheel tractor is typical. The newspaper-reading "pedestrian" is just one of the hazards.

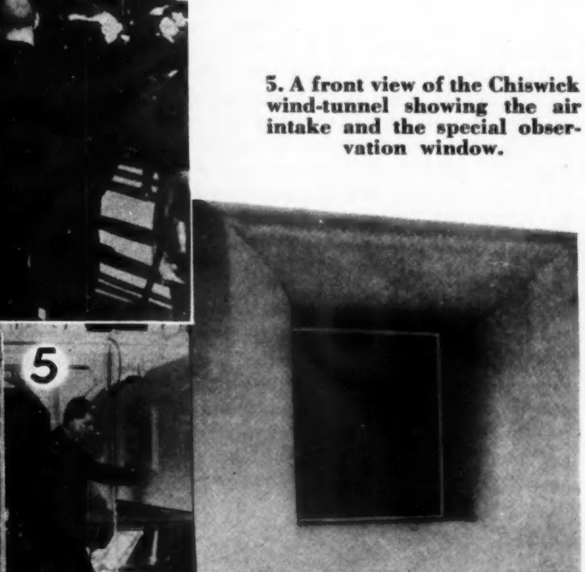
The WORLD on WHEELS



2. The U. S. army ordnance department puts a new 13-ton tank through its paces at the Aberdeen proving grounds.

3. Five mobile stores like this one recently made their appearance on Moscow streets. They are backed by the Peoples' Commissariat of Home Trade.

4. Among the many features of the London omnibus laboratories at Chiswick is the special wind-tunnel for testing air resistance. A model bus inside the tunnel is being observed through a special window.



5. A front view of the Chiswick wind-tunnel showing the air intake and the special observation window.

Acme, International, Keystone and Topical photos

Value of May Automotive Exports Up 21%

First Five Months This Year Show 10% Increase Over 1935; Passenger Car Shipments Abroad Were 29% Higher in May

Exports and Imports of the Automotive Industry for May and Five Months Ended May, 1936-1935

EXPORTS	May 1936		May 1935		Five Months Ended May 1936		Five Months Ended May 1935	
	Number	Value	Number	Value	Number	Value	Number	Value
Motor Vehicles, parts and accessories	....	$22,531,868	....	$18,582,802	....	$113,684,770	....	$103,377,038
PASSENGER CARS								
Passenger cars and chassis	17,570	9,576,502	13,604	8,031,216	85,668	49,100,967	79,031	44,445,320
Low price range $850 inclusive	16,224	8,016,834	12,316	6,624,343	78,238	40,803,524	73,148	37,925,818
Medium price range over $850 to $1,200	1,043	1,017,208	944	883,254	6,106	5,873,319	4,324	4,128,996
$1,200 to $2,000	221	326,288	149	224,668	893	1,308,529	673	1,037,618
Over $2,000	82	216,172	94	257,869	431	1,115,595	440	1,174,565
COMMERCIAL VEHICLES								
Motor trucks, buses and chassis (total)	10,806	5,383,814	6,291	3,340,315	48,689	24,356,568	36,560	19,115,867
Under one ton	1,551	607,172	523	178,215	7,239	2,714,257	3,099	1,042,232
One and up to 1½ tons	7,280	3,303,660	4,421	2,043,802	31,917	14,598,072	26,892	12,007,519
Over 1½ tons to 2½ tons	1,349	936,703	1,066	776,782	6,516	4,588,097	5,367	4,160,242
Over 2½ tons	321	376,611	199	283,227	1,462	1,801,657	941	1,701,807
Bus chassis	305	159,660	26	26,345	1,555	654,485	122	138,502
PARTS, ETC.								
Parts except engines and tires	....	......	....	......	....	......	....	......
Automobile unit assemblies	....	4,004,412	....	3,903,160	....	22,753,191	....	24,404,847
Automobile parts for replacement (n.e.s.)	....	2,454,283	....	2,268,903	....	10,818,621	....	10,564,510
Automobile accessories (n.e.s.)	....	271,842	....	257,038	....	1,380,408	....	1,311,308
Automobile service appliances	....	412,857	....	392,391	....	1,803,861	....	1,731,220
Airplanes, seaplanes and other aircraft	35	739,932	39	836,324	149	2,540,975	167	4,262,953
Parts of airplanes, except engines and tires	....	568,089	....	375,420	....	1,840,203	....	1,925,319
INTERNAL COMBUSTION ENGINES								
Stationary & Portable:								
Diesel and semi-Diesel	27	66,014	10	36,061	162	549,092	123	312,035
Other stationary and portable	....	......	....	......	....	......	....	......
Not over 10 hp.	970	57,818	914	52,987	4,540	302,853	3,631	220,882
Over 10 hp.	150	67,763	79	52,087	1,160	411,411	525	320,411
Automobile engines for:								
Motor truck and buses	1,150	93,790	461	68,468	11,049	1,047,543	1,763	287,177
Passenger cars	3,997	245,234	3,824	228,257	25,612	1,733,380	15,579	988,468
Engines for aircraft	51	229,575	51	195,793	265	1,258,395	210	733,559
Accessories and parts (carburetors)	....	180,212	....	169,270	....	839,055	....	687,120
IMPORTS								
Automobile and chassis (dutiable)	69	34,968	57	35,228	274	116,712	203	111,634

More Space for Buick

(Continued from page 889)

An entirely new transmission plant will be built which will have a capacity of 70,000 transmissions a month. This plant will be 1027 by 138 ft., a monitor type building, one story high in the main section with a two-story section to accommodate dining room, locker rooms and offices. In addition a new heat treatment building will be erected to handle all heat treating of transmission parts. Upon completion, transmission production will be moved, releasing the present transmission building, which is a new and modern plant, for other use.

Into the vacated building will be moved the service parts manufacturing to improve material handling and storage facilities and to get material into fireproof buildings the floor space will be doubled. The two old buildings will be destroyed, marking the passing of the old Imperial Wheel Works Plant, one of the industrial wonders of its day.

Another building will be erected to house the master mechanics division, the works engineering division, personnel department, metallurgical and standards division, a branch office of purchasing and the factory police department. This building will be three stores, 240 by 220 ft., providing approximately 150,000 sq. ft. of floor space, and will be serviced with railroad tracks, pavements, roadways and docks to care for general stock keeping, maintenance and construction.

Other plans include construction of a new heat treating department for the gear and axle plant, present facilities being inadequate. It will be a fireproof structure of increased size and capacity to assure continuity of processing.

Litz Failure to Finish Was Caused by Broken Crankcase

The technical observer's original report on the cause of the withdrawal in the 170th lap of the Litz Special, driven by Deacon Litz in the Indianapolis 500-mile race, has been declared incorrect by the American Automobile Association. The actual cause of the trouble was a broken crankcase and timing gear housing, according to latest advices from A.A.A. Contest Board.

Acklin Stamping Co. Gives Five Per Cent Wage Increase

Employees of the Acklin Stamping Co. have been granted a 5 per cent wage increase, according to an announcement by Frank E. Graper, vice-president and general manager. About 200 employees are affected.

Publications Available

Charts showing the **elongation of No. 5 Zinc Base die cast alloy** under various heats and pressures are contained in Metalgram No. 12*, publication of the Apex Smelting Co., Chicago.

"Chips"* is the title of a new **house organ by Barber-Colman Co.,** Rockford, Ill. Vol. 1, No. 1, for May is most interesting—is headed "An Adventure in Friendship." Shall we put your name on the list?

Several pieces of literature* have recently been received from the Mattison Machine Works, Rockford, Ill. They cover the company's line of **automatic lathes, internal and surface grinders, moulders, and sanders.**

A new 208-page catalog* devoted exclusively to **power transmission equipment** has just been published by the Link Belt Co., Chicago. Full details of the company's line together with a valuable cross indices are contained.

American Tentative Standard **Safety Code for Safety Glass** has been published by the American Standards Association, 29 West Thirty-ninth St., New York, N. Y. Full descriptions of the various safety tests are given together with the tentative standards. Available from the publishers. Price 20 cents.

Plating and polishing equipment and supplies by the Udylite Co., Detroit, Mich., is the subject of the company's newest catalog*, which describes the line, including full electrical equipment, solvent machines, buffing and polishing wheels.

*Available from AUTOMOTIVE INDUSTRIES.

"Budd Duals" is the title of the 1936 catalog* on wheels, hubs and parts for commercial vehicles distributed by the Budd Wheel Co., Detroit. Like its predecessors this catalog is amazingly complete in the information which it contains, including much valuable data regarding operation practices.

An interesting folder* comes to our attention from Federal Products Corp., Providence, R. I., regarding Federal Dial Indicators. That **gages can bring about the same work from different hands,** is the theme.

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* Available from AUTOMOTIVE INDUSTRIES.

CHARLES B. BOHN, president of the Bohn Aluminum and Brass Corp., has sailed for a tour of Europe during which he will study engineering developments abroad.

PARK M. SMITH, formerly assistant director of the Bureau of Motor Carriers of the I. C. C., has become associated with Keeshin Transcontinental Freight Lines, Inc. Prior to his affiliation with the I. C. C. Mr. Smith was connected with the Greyhound Management Corp. and the Minnesota Railroad and Warehouse Commission.

C. B. COOK, formerly sales manager of the Edison-Splitdorf Corp., has joined the J. A. Tumbler Laboratories in the same capacity.

Car Shortage Predicted

(Continued from page 889)

required to mail out checks to the veterans. Only a small percentage was able to convert bonds into cash last week. So far, dealers have been disappointed at the volume of bonus business that has developed but they are still hopeful that, as the money gets into circulation, a good part of it will find its way to dealer show rooms or used car lots.

On June 12 Chevrolet sales this year surpassed 582,964 units, a figure which has stood since 1928 as the company's all-time record for the entire first half of any year. By the end of June, sales are expected to exceed the six-months' record by about 80,000 units. It is estimated that 1935 first half sales will be exceeded by approximately 50 per cent.

Delivery of 2200 De Soto taxicabs currently being made to the Sunshine Radio System, Inc., New York, is the largest single order in the company's history and represents the largest number of taxicabs ever to be placed in use in any city at one time.

Retail sales of Hudson and Terraplane cars during the first two weeks of June totaled 4977 cars. This is better than for any similar June period since 1929 and represents a gain of 52 per cent over last year.

As of June 20, Oldsmobile dealers had sold 103,265 cars so far this year, and during the second 10 days of June, 7644 cars were delivered, a gain of 14.5 per cent over the first 10 days and 29.7 per cent ahead of the same period last year.

Robinson-Patman Bill Helps FTC

New Law Hits Price Discrimination, Secret Commissions; May Bring New Light on Goodyear-Sears Case

The Robinson-Patman anti-price-discrimination act, passed by Congress in the closing days of the last session and signed by the President June 20, is being studied by legal departments of the motor companies for a determination of the effect it will have on trade practices of the industry. Company officials were reluctant to express any opinions until interpretations were in hand from the legal departments. Offhand comment indicated that the practical effect on automobile companies was likely to be small, that the law would not concern automobile sales departments so much as their purchasing, where buying practices as regards original equipment may be subject to modification.

John W. Blanchard, counsel for the A.P.E.M., has prepared a bulletin for members of the association, outlining the major provisions of the act and discussing some of their effects on sales practices in the parts and equipment field.

"In our opinion," says the bulletin, "this is one of the most important acts of the present Congress and will have a very wide effect on sales practices in this industry.

"This act is so broad and sweeping in its terms that it is bound to have a sharp influence on sales and trade practices throughout the country. It applies not only to sales by manufacturers, but to sales by wholesaders, retailers and others, and may require changes throughout the entire distribution system. One of the chief objects of this act is to eliminate the claimed discriminatory advantages of large organizations such as the chain stores. But it goes much further than this and is claimed by some to affect other groups more than it does the chains.

"In our analysis we noted a few of the questions of interpretation which will arise. There will be many more. Most of these questions will have to be decided in the first instance by the Federal Trade Commission. Whether they will be strict or liberal in their policies is yet to be seen. The real effect of this act cannot be accurately determined until it has been in effect for a while and the commission has had a chance to rule on some of the many complex questions.

"Another important factor in determining the ultimate effect of this act is the possibility of loopholes and legal avoidance. The many exceptions and qualifications to Section 1 were outlined in the bulletin, and we may expect a studied attempt by many to come within those exceptions and 'get out from under' the act.

Most important of the terms in the Robinson-Patman bill, passed by Congress and signed by the President, is the provision which makes it unlawful for anyone engaged in interstate commerce to discriminate in price between different purchasers of commodities of like grade and quality, where the effect of such discrimination may be substantially to lesson competition or tend to create a monopoly in any line of commerce.

Specific mention is made of the fact that the bill is not intended to prevent price differentials which make only due allowance for differences in the cost of manufacture, sale or delivery resulting from differing methods of quantities. Nor is it intended to prevent persons from selecting their own customer in bonafide transactions and not in restraint of trade. Special sales are permitted by a clause which permits price changes to meet the changing market value of goods, especially those subject to deterioration or obsolescence.

The Federal Trade Commission is empowered after due investigation and hearing to establish quantity limits where it finds that available purchasers in greater quantities are so few as to render differentials unjustly discriminatory.

The burden of proof is specifically placed upon the person charged with a violation, and the commission has the authority to terminate the discrimination. The bill provides, however, that nothing shall prevent a seller from lowering his price to meet an equally low price of a competitor.

A series of clauses further provides that it shall be unlawful to give or receive anything of value as a commission except in payment of services rendered. This is extended to include special discounts, rebates, allowances or advertising service charges, or the selling of goods at unreasonably low prices for the purpose of destroying competition or eliminating a competitor. Cooperative associations are specifically permitted to return all or part of their earnings resulting from trade transactions to their members.

Finally, the bill contains a provision which permits the reopening by the Federal Trade Commission of any proceedings which it may have already handled, regardless of the ultimate decision, and may serve its complaint supplementary to the original complaint. If upon review, the court should set aside the amended order, the original order shall remain in force.

As it is well known that much of the Robinson-Patman bill was given impetus by complications arising from the Goodyear-Sears case, the bill is looked upon as strengthening the commission's position in the case. Particularly the last mentioned provisions, regarding the reopening of a case, and the reverting to the original order should the new case fail, seem to have been designed largely with this case in mind.

Automotive Metal Markets

Steel Mills Busy Completing and Shipping Orders; Small Lots Being Tested for New Models

By William Crawford Hirsch

Recent developments in the market for cadmium, for years looked upon as one of the non-ferrous metals of minor importance, strikingly illustrate the influence of automotive consumption on the expansion of a metal's scope.

When the price of cadmium jumped last year to $1 per lb., the steadily growing consumption of the metal as a base in automotive bearing alloys was suddenly jeopardized. Recognizing the danger of the situation, some cadmium sellers are reported to have lowered their price to 75c. in contracts with manufacturers of bearing metals for automotive uses. So far the market price to electroplaters remains at from 90c. upwards, the 75c. price having been established only in contract transactions with bearing metal makers.

For many years cadmium sold at around 55c., and it was this factor that caused its adoption in certain bearing metal formulas, the addition of a small percentage of silver and copper giving the alloy a highly desirable combination of properties. While in former years, 2,500,000 lb. a year was looked upon as a normally heavy consumption, last year sales of more than 4,000,000 lb. were recorded, largely as the result of consumption in automotive bearings. With the price of cadmium at 75c. on a contract basis, the outlook for further expansion is considerably brighter.

In the steel market, some small lot business for experimental try-outs in connection with new model dies is reported to have been placed. The all-overshadowing activity of mills is in the completion and shipment of orders placed at second quarter prices. The steel industry is coming nearer and nearer to grips with a number of internal problems, upon the solution of which depends to some extent the market's future price structure. Chief among these is the problem of wage scales. There are also rumors that the abolition of the basing point system will again come up for consideration at the next session of Congress.

Pig Iron—Demand from automotive foundries is holding up fairly well. Sellers believe that, if steel prices hold steady in the third quarter, there will be more disposition to cover future pig iron needs by way of protection against advances later in the year.

Aluminum—The market for both primary and secondary aluminum is steady and unchanged.

Copper—Domestic consumption is very much along the same lines as was that in May, bookings so far aggregating around 12,000 tons. They were around 16,000 tons in May. Prices are entirely unchanged.

Tin—After a sharp sag, tin prices stiffened at the opening of this week's market when spot Straits was held at 42 cents. There was quite a little buying by consumers during the bargain period of the preceding week. Some of the forecasts of what will be done at the impending meeting of the International Tin Committee emphasize that the "bears" are likely to be disappointed in their expectations of a lifting of production quotas.

Lead—Quiet and unchanged.

Zinc—Steady and unchanged.

Elihu H. Cutler

Elihu H. Cutler, old-time member of the automobile industry and head of the Knox Automobile Co. when it was producing a three-wheeled, air-cooled "horseless carriage," died on Sunday, June 21. As president of the Association of Licensed Automobile Manufacturers, which was organized in 1903, he was active in the litigation against Henry Ford concerning the basic Seldon patents. Many years ago, however, Mr. Cutler traded in his motor rights for the wholesale grain business and retired altogether in 1927. He was 80 years old.

Anchovies for Motors Is Spanish - Italian Barter

Special to AUTOMOTIVE INDUSTRIES

An agreement has been reached between Spain and Italy, according to a statement made in Barcelona recently by the Spanish Minister of Industry and Commerce, Senor Alvarez Buylla, for the exchange of anchovies from Spain for automobiles and trucks made in Italy. The treaty stipulates that the trucks shall be imported only partially completed so that not more than 25 per cent of the labor going into their construction shall be Italian, and the balance, Spanish.

The Italian accord is not likely to affect imports of American vehicles in Spain, in the opinion of representatives of U. S. factories in that country, since prices of Italian cars are well above those of American products of similar characteristics.

Buick and Chrysler Among Forbes Contest Winners

The $15,000,000 Buick modernization program, described in full in the June 6 issue of AUTOMOTIVE INDUSTRIES, was awarded a special prize in the Industrial Modernization Contest recently conducted by *Forbes Magazine*. Special mention was made of the fact that Buick had spent on the modernization program a sum equal to 25 per cent of its entire previous building investment.

Honorable mention was also awarded to the Chrysler Corp. for the installation of modern air conditioning in a large Detroit plant. First award in the contest went to the International Business Machines Corp. for its developments at Endicott, N. Y., while second and third prizes were awarded the Pennsylvania Railroad and Indianapolis Railways respectively.

Calendar of Coming Events

SHOWS

International Automobile Section, 7th Levant Fair, Bari, Italy	Sept. 6-21
Automobile Salon, Oriental Fair, Lwow, Poland	Sept. 5-15
30th Automobile Salon, Paris, France,	Oct. 1-11
Olympia Motor Show, London, England,	Oct. 15-24
Czechoslovakia, 26th International Automobile Exposition, Prague	Oct. 16-25
9th International Automobile Salon, Milan, Italy	November
National Motor Truck Show (N. J. Motor Truck Assn.), Newark, N. J.,	Nov. 3-7
National Automobile Show, Grand Central Palace, New York	Nov. 11-18
International Aviation Show, Paris, France	Nov. 13-29
Boston Automobile Show	Nov. 14-21
Columbus Automobile Show	Nov. 14-20
Chicago Automobile Show	Nov. 14-21
Detroit Automobile Show	Nov. 14-21
Washington, D. C., Automobile Show,	Nov. 14-21
Cincinnati Automobile Show	Nov. 15-21
St. Louis Automobile Show	Nov. 15-22
Brooklyn Automobile Show	Nov. 21-28*
Cleveland Automobile Show	Nov. 21-28
Kansas City Automobile Show	Nov. 21-29*
Milwaukee Automobile Show	Nov. 22-29
Baltimore Automobile Show	Nov. 26-Dec. 5
28th Automobile Salon, Brussels, Belgium	Nov. 28-Dec. 9
Peoria Automobile Show	Nov. 30-Dec. 5*
Philadelphia Automobile Show,	Nov. 30-Dec. 5*
Natl. Exposition of Power & Mechanical Engineering, Biennial Meeting, New York City	Nov. 30-Dec. 5
Automotive Service Industries Joint Show, Chicago	Dec. 9-14

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* Tentative dates.

CONVENTIONS AND MEETINGS

American Society for Testing Materials, Annual Meeting, Atlantic City	June 29-July 3
National Association Power Engineers, Annual Meeting, Chicago,	Aug. 31-Sept. 4
American Chemical Society, Semi-annual Meeting, Pittsburgh, Pa.,	Sept. 7-12
World Power (Fuel) Conference, Washington, D. C.	Sept. 7-12
American Transit Association, Convention, White Sulphur Springs, W. Va.	Sept. 21-24
First Aircraft Production Meeting of the S. A. E., Los Angeles	Oct. 14-16
American Society for Metals, 18th Nat'l Congress, Cleveland, O.	Oct. 19-23
American Gas Association, Annual Meeting, Atlantic City	Oct. 26-31
American Petroleum Institute, Annual Meeting, Chicago	Nov. 9-12
Natl. Industria Traffic League, Annual Meeting, New York City	Nov. 19-20

Just Among Ourselves

An Idea We Might Borrow

IT has been our experience that automobile drivers, when operating in strange territories, tend to favor chain-operated filling stations when they need gas and oil. Maybe it is because they feel that by so doing they are more likely to get fuel and lubricants of suitable quality. But we are inclined to believe that the generally high standard of cleanliness of the toilet facilities of such stations is also of real importance.

Anyway, judging by the efforts oil companies make to keep these facilities clean, they apparently think they are a major sales factor. Standard of Pennsylvania and of New Jersey, for example, require their station operators to inspect and, if necessary, clean these facilities every two hours between 7 A. M. and 11 P. M. and every four hours during the remainder of the day. These companies have a special form on which the attendants report the performance of these duties.

It seems to us that there is an idea in this which car factory sales promotion departments might well pass on to dealers, particularly those who cater to transient traffic. If the public got to know that automobile dealers generally provided as clean toilet facilities as do filling stations, perhaps they would get more of this tourist business.

* * *

IT is not uncommon to find legislators damning the sales tax in one breath and urging an increase in the gasoline tax in the next, apparently without any realization that they are contradicting themselves.

* * *

Features of Future Models

TO get propeller-shafts lower, many 1937 models have hypoid rear axle gears. . . . At least one car maker will add a turn signal to his list of factory approved accessories next year. . . . Some real improvements in front-end designs to provide better visibility for the driver may come in 1937 but are more likely in 1938. . . . Driver's seats with vertical adjustment are coming and in the future this seat will be designed for a more upright position. . . . Flush type door handles for appearance, reduced wind resistance and safety are on the way. . . . Overdrives will be offered more generally next year. . . . More cars are expected to have power gear-shifting. . . . At least one more maker may adopt the supercharger and another is expected to use hydraulic valve lifters. . . . Rumors persist that one of the leading producers in the lower priced field will add a smaller model to his line.

* * *

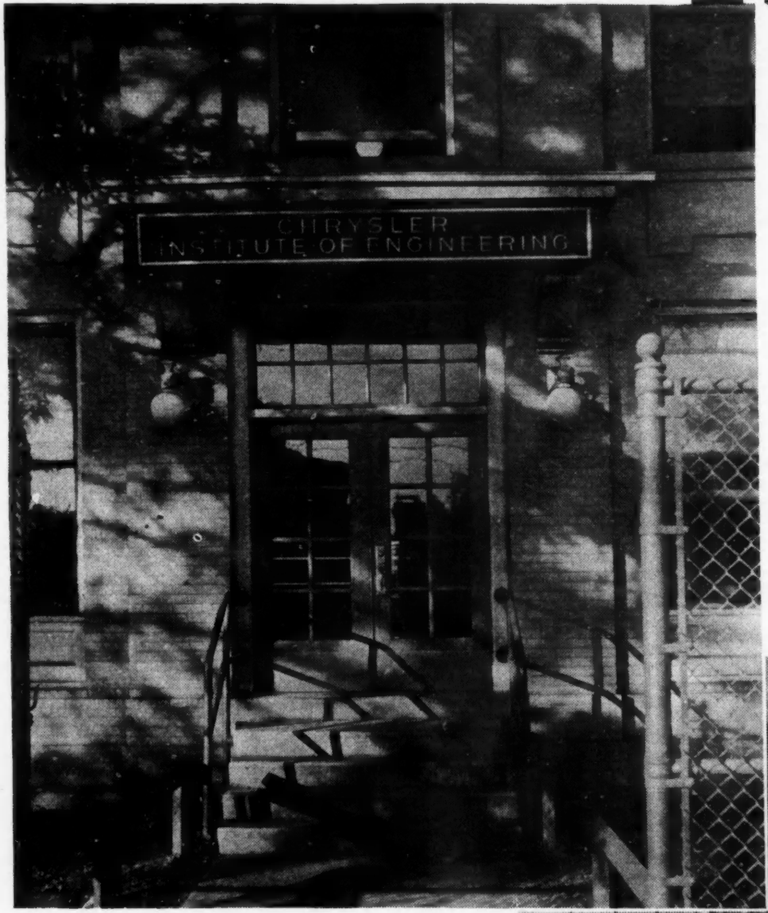
Light on the Danger Spots

IF the $12,000,000 which New York plans to spend annually on grade crossing elimination were used for highway lighting, 10,000 accidents a year could be prevented as contrasted with the 151 accidents which it is estimated grade crossing eliminations will prevent, according to D. M. Diggs of the General Electric Co. In Mr. Diggs' opinion, there are 50,000 miles of highways which need lighting at once to reverse the trend of night accidents. The cost of such lighting would be about $135,000,000 which represents about 5 per cent of the original cost of the highways.

In this connection, it seems to us that Studebaker President Paul Hoffman made a fine suggestion at the SAE summer meeting. He proposed that studies be made to determine the points on our highways where night accidents have been frequent and that a start be made by lighting these points. Such a program should bring immediate results at a moderate cost. Moreover, it would be a start on the big job of lighting all trunk highways.—D. B.

The Proving

By Harold E. Gronseth



The Chrysler unit of higher education for automobile men recently had a list of 4000 applicants for 30 openings in an engineering class

The Ford school was started in 1916 and has graduated many into a field of greater usefulness. Here are a few of the students at lunch

APPRENTICE training is not an uncommon thing in industry, but few realize the scope of the educational systems set up for employes by the leading motor companies. From simple instruction in automotive mechanics to graduate work leading to the degree of Doctor of Mechanical Engineering, is the span of academic courses offered in the mechanical arts. In addition there are courses in accounting, finance, salesmanship, secretarial work, executive training, and other special subjects.

No longer can industry be regarded solely as a "college of hard knocks." Factories have become institutions of higher learning and, in a true sense, thousands of workers now scaling the educational ladder will look back upon their employing companies as their "Alma Mater." In the factory class rooms can be found, besides the thousands of workers ambitious to become more proficient at bench or lathe, shop foremen getting the fine points of industrial relations, young engineers delving into the mysteries of thermodynamics and the intricacies of machine design, embryo executives acquiring ground work in business administration, and high ranking officials adding to their other accomplishments the art of public speaking.

No stately elms nor well-kept lawns grace these campuses—only railway sidings, belching smoke stacks and piles of raw materials. Realism replaces college spirit. Their laboratories are the richly endowed machine shops, research and engineering departments of the world's greatest industry. Instructors are practical minded shop superintendents, industrial engineers of note, and outstanding business leaders. There are instances where teacher and pupil alternate—classes in which practical men teach theoretical men in the daytime and the latter, some former college professors, teach practical

Ground is their Campus

and experience their most important instructor. Courses in a range beginning with shop procedure up to higher mathematics and engineering are offered at the trade schools operated by the automobile manufacturers

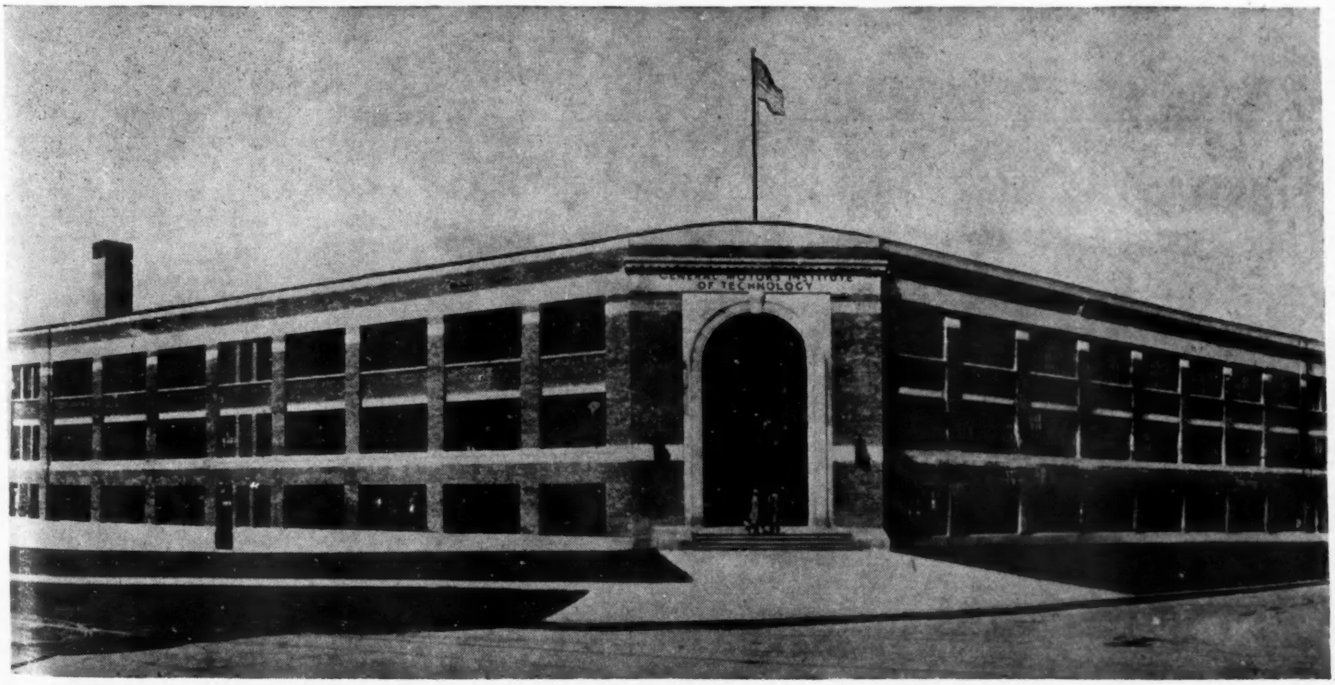
men at night. From the alumni of these schools have come a number of men now occupying responsible positions in the industry and some have made noteworthy contributions to automotive engineering.

Attendance and the number of applications for enrollment attest to the popularity of the courses being offered. The Henry Ford Trade School is able to admit only 1 per cent of the applicants. As many as a thousand boys have applied for admission in a single day. More than 10,000 men and women received instruction in the varied courses of the General Motors Institute at Flint during the last academic year. The Chrysler Institute of Engineering, forming a new class in advanced engineering, recently picked 30 candidates from a group of 4,000 applicants.

Matriculation is not confined to present or prospective employes. Promising young men from dealerships are given instruction in salesmanship and service. Training is provided for high school teachers who instruct the 19,000 students enrolled in auto mechanics study in public schools. In a recent course in diesel engine instruction, 19 railway transportation experts were enrolled. Tuition, generally scaled to the minimum, varies with the courses and the schools. Some students enter school on a salary basis; others pay as they go, as in any college; while the majority, enrolled in spare time courses, earn as they learn.

Such is the modern and glorified form of apprenticeship as exemplified by the educational systems organized, along different lines, by the three major automobile companies. The schools serve a two-fold purposes of providing young men growing up in the industry with specific and practical training and at the same time provides management with a proving ground for personnel. So swift has the motor industry progressed that managements long ago recognized the advantages if not the necessity of training their own technical experts. College laboratories have been unable to keep pace with the rapid developments in the industry. Even text books become obsolete before they are put to use. To insure proper development of present and future man power and to open wider the door of

The General Motors Institute is the outgrowth of a spare time course which began in 1918. The Institute dates from 1926



opportunity for their employes is why these manufacturers have gone so extensively into educational work.

First to enter the field was the Ford Motor Company. Back in 1916, the Henry Ford Trade School for younger boys was launched, opening in October that year with six boys and one instructor. Now 4,500 students are in training with the company which has supplemented its activities in educational work with an apprentice school for shop workers and the more recently organized Ford Training School for high school graduates.

General Motors Institute at Flint is the outgrowth of a spare time program of education founded in 1918 by the Industrial Mutual Association of that city and taken over by the corporation in 1926 when the scope of its program was materially broadened. Already more than 40,000 men and women have availed themselves of the opportunities provided by the Institute.

The Chrysler Institute of Engineering, youngest of the three schools and the only one to offer graduate work and grant college degrees, was incorporated under charter of the State of Michigan in June, 1933. So far only engineering degrees have been granted but the school has been expanded to include courses in commerce and finance and various high school subjects. Approximately 1,200 students are entered in day and night classes.

While the diversified educational activities being conducted by the three companies serve a definite purpose and were adapted to their specific needs, they fall far short of maintaining the ranks of skilled workers in Detroit's manifold industrial and mechanical occupations. With the recovery of business, manufacturers recognized the necessity for training future craftsmen to fill the places of those lost through promotion, death, superannuation, new occupations and other reasons, a loss estimated at 5 per cent annually. With 66,000 craftsmen engaged in skilled trades in Detroit, it is necessary to train 3,300 new men annually for replacements alone.

This realization started the employers thinking about apprenticeship training. In February last year, 65 executives of Detroit industries met in the Wilbur Wright Vocational High School to discuss the problem. A committee was appointed to act as a steering body, to assemble facts and to formulate a definite procedure to train apprentices in cooperation with the public education authorities of Detroit. Impetus was given the movement by the abolishment of the NRA which removed the fear of Government supervision. Then late last fall a definite and "simon-pure" apprenticeship program was launched. Three plans were made available to employers.

(A) The standard cooperative plan: After one year full time (all day) trade training at the Wilbur Wright School, then; Two years alternate two-week intervals work and school, and two or more years full-time employment, with four or eight hours of school per week. Boys enter this program at the approximate age of 17—finishing at the age of 21. This plan requires the approval of department for training by the Department of Labor. During the first year, selected boys are placed eight hours per day in the shop and in related work at school. During the second and third years, all school time is on related subjects. During the last years, school work will be in the nature of advanced information pertaining to the job. All years are to be considered as fifty weeks (of forty hours each), or approximately 2,000 hours.

(B) The advanced cooperative plan: After two years full time (all day) trade training at the Wilbur Wright School, then; One year with alternate two-week intervals, work and school, and two years full time employment, with from four to eight hours of school per week. Boys enter this program at approximate age of 16, and are 18 at time of entering employment—finishing at the age of 21. This plan does not require the approval of the Department of Labor.

(C) The extension training plan: After three years full time (all day) trade training at the Wilbur Wright School or the Cass High School, then; Three years full time employment and four or eight hours of school per week, or after three years full time (academic or standard) high school training, then; Three and one-half years full time employment, and from four to eight hours of school per week.

Members of the Detroit Manufacturers' Committee on Apprentice Training are: Chairman, H. W. Boulton, Murray Corp.; John M. Amiss, Chrysler Corp.; Ray Booth, National Metal Trades Assn.; O. F. Carpenter, Detroit Board of Education; M. A. Clark, United States Rubber; M. A. Heidt, Budd Wheel; L. R. Judson, Timken-Detroit; H. J. Roesch, Briggs Mfg., and Albert Sobey, General Motors.

The apprentice program is being directed by O. F. Carpenter, formerly principal of the Wilbur Wright Vocational High School, who has been loaned for a year to the Employers Association of Detroit, principal sponsor of the apprenticeship movement. Other organizations endorsing the plan are: the Detroit Board of Education, Michigan Manufacturers Association and the National Metal Trades Association.

Since the program was started, the committee has placed over 800 apprentices, of which approximately 200 have been from the outside, the balance being transferred from casual work within the plants to departments having apprentice programs. More than 500 applicants are on the waiting list. The plan contemplates placing a minimum of 1,000 men a year, so that by the end of three and one-half years when the first C group finishes, there will be 3,500 youths in training. It is hoped eventually to increase the number to 12,000. Minimum pay for apprentices has been established by the committee at 35 cents an hour, but as yet no employer has taken advantage of the minimum, actual rates ranging from 40 cents to 55 cents an hour. The plan contemplates automatic increase of 5 cents an hour, every six months to successful students.

The Chrysler Institute of Engineering was chartered in 1933 and is the only one to grant college degrees. Here is a picture of the first graduating class.

The Horizons of Business

By Joseph Stagg Lawrence

The Will of Caesar

THE new tax bill as finally passed has been euphemistically termed a compromise, i. e., a compromise between the reform statute etched by the White House and the more practical tax bill evolved by the Senate. As a "compromise" it recalls the old gag about the wife and husband. She wanted to go out. He wanted to stay home. So they compromised and went out. The administration wanted reform. The Senate wanted a tax bill. So they compromised with reform.

No one who has followed this last major "must" measure of the New Deal can have any doubt regarding its real purpose. The Upper House and those representatives of business who were accorded a hearing were united in agreeing that the revenue of the government should be increased. Business men were willing to dig into their personal and corporate jeans to help Uncle Sam meet his legitimate needs. However they had the effrontery to suggest that the government should reduce its costs, should levy taxes in whatever manner would least injure the continuing capacity of the taxpayer to produce income, should refrain from demoralizing large groups of the working population and in general confine itself to those fields which the Constitution enumerates as the province of the Federal government. All this was rash impudence on the part of business, patently reactionary and a crass effort to supersede "human" with "poverty rights." The bill as passed is a monument to the failure of this effort.

The Faintest Possible Praise

The original house bill was a masterpiece of verbal contortionism and legal obfuscation. In spots it sounded as though conceived by the brain trust in the late stages of a gin party and drafted by Gertrude Stein. It provided seemingly unending material for editorial satire. The present bill is an improvement in that its purposes are reasonably clear. The quadratic equations are eliminated. Nor do verbs, adjectives, pronouns, qualifying conjunctions, etc., play hide and seek with each other in the baffling manner of the earlier bill. However that is the best that can be said of the new measure, towit, that it is not as bad as the original House bill.

Concealing Earnings

In the first place no one knows how much revenue this bill will produce, a fact which, significantly, does not seem to disturb the Treasury. In trying to estimate yield the experts of the Fisc are contending with no less than four major unknowns. Since this is a tax on corporate earnings the aggregate of such earnings is the first unknown. In wrestling with this "x" the Treasury must guess the course of business, estimate the effect of a hypothetical change in business upon earnings and then estimate the probable statement of earnings by business management. For admitted earnings are not an inflexible mathematical function of business operation. Business costs have an elastic range. The precise amount of depreciation, for example, though it may be limited at one end by regulations of the Bureau of Internal Revenue, rests in fact largely upon the discretion of management and the treatment of the accountant. Under this bill the temptation to hide earnings is powerful. It will tend to make the average business man a tax dodger and, in view of the manner in which this particular measure was imposed from above, conscience can offer but frail objection.

Who Knows How Much?

The second unknown is the precise apportionment of earnings among corporations in accordance with their exposure to the graduated normal tax schedule. What earnings will be subject to the 8 per cent normal tax, the 11 per cent, 13 per cent and 15 per cent tax? After the clairvoyant footsoldiers of Mr. Morgenthau get this answer they will have to tune in on board meetings and the more subjective deliberations of a half million corporate managements to determine how many will retain up to 10 per cent of their earnings after the normal tax, which 10 per cent is subject to a super tax of 7 per cent, how many will retain an additional 10 per cent, which is subject to a super tax of 12 per cent, etc., through the five classes of retained profits. Having decided what business will do in the coming fiscal year, how it will affect corporate earnings, how these earnings will be distributed according to size and in what way managements will share them with stockholders the Treasury can then ascertain the change which such a division will make in individual incomes and the revenue which the increased levies on personal incomes will yield.

The estimate of an $800 million yield is a pure guess for a rational calculation is out of the question. Were it correct it would be less than a third of the deficit for the current year. Since the prevailing corporate taxes upon capital stock and excess profits are retained (the latter are strengthened) it cannot be said that the measure simplifies the corporate tax structure. This eliminates the legitimate motives of the measure and reveals it as a clear attempt to regulate corporate size and policy.

Abusing the Principle of Progression

A study of the progressive features of the bill further supports this conclusion. The theory of progression as applied to personal income taxation is sound if it is not abused. The proposition that a wealthy individual should pay a larger fraction of his income to the government than a person of more moderate means is not open to debate. It becomes mischievous only when politicians draw the scale so that the bulk of the revenue is paid by individuals whose votes are such a disproportionately small fraction of the total that they fail to act as brakes upon the extravagance of government or to punish irresponsible legislators.

Penalizing Size, Success and Foresight

The theory of progression in taxation seeks to equalize the tax burden as between individuals of varying income. A man with a hundred thousand dollars income can pay a 25 per cent tax as easily as a five thousand dollar a year man can pay 4 per cent. To apply this

(Turn to page 918, please)

The Forum

Correction Factor in Fuel Economy

Editor Automotive Industries:

I have read with interest Mr. Heldt's article on correction factors as used in engine tests, in a recent issue of Automotive Industries.

In regard to the correction for fuel economy, it seems to me that some correction should be made, due to the fact that a low barometer will cause a low compression pressure, thereby lowering the thermal efficiency with practically the same effects as lowering the compression ratio. It does not seem practical that this loss should be charged against fuel consumption. We have done considerable work here on making comparisons on tests, and we find we get a very good check on horsepower when we correct for barometer, which has been corrected for humidity to drier conditions and also for temperature. We cannot, however, make comparative fuel runs unless we apply correction for barometer changes.

G. W. Hobbs,
Associate Professor,
Michigan State College.

There is no real need for a correction for atmospheric density to the observed specific fuel consumption. The thermal efficiency of the engine does not depend on the compression pressure but on the compression ratio, as implied in the expression for the thermal efficiency of the Otto cycle

$$[1-(1/r)^{\gamma-1}]$$

and is therefore independent of atmospheric conditions. What is known as the brake thermal efficiency, of course, does vary slightly with the atmospheric density, but in my opinion the change in this factor with atmospheric density within the range of conditions under which fuel consumption tests are usually made is so small as to be negligible.

Pumping losses evidently go up and down with the atmospheric density, while the friction losses are constant and independent of atmospheric conditions. At the peaking speed the friction losses are equivalent to about 15 lb. per sq. in., while the pumping losses under full load amount to about 5 lb. per sq. in. The b.m.e.p. at full load is about 90 lb. per sq. in., and the indicated m.e.p. therefore is 110 lb. per sq. in. The mechanical efficiency under these conditions is $90/110 = 0.8182$ or 81.82 per cent.

Now assume that the atmosphere has a density of, say, 4 per cent above normal, which is a very large variation from normal, considering the conditions under which engine tests are usually made. Then the i.m.e.p. is

$110 \times 1.04 = 114.4$ lb. per sq. in.

The pumping losses are

$5 \times 1.04 = 5.2$ lb. per sq. in.,

and the friction loss is again 15 lb. per sq. in., so that the b.m.e.p. now is $114.4 - 5.2 - 15 = 94.2$ lb. per sq. in. and the mechanical efficiency is

$94.2/114.4 = 08234$ or 82.34 per cent.

The mechanical efficiency therefore has increased from 81.82 to 82.34 per cent or in the ratio of 0.63 per cent. It would be legitimate to make a correction of this order in the specific fuel consumption. However, the average correction factor for horse power is much less than 4 per cent and probably not more than one-third or one-fourth this value. The fuel-correction factor goes up and down with the horse-power correction factor but is less than one-sixth as great. For a horse-power correction factor of 1 per cent, for instance, it would be only 0.15 per cent, which is so small that it may be neglected, particularly because the probable error of the test results is considerably greater.

Of course, if engine tests were made at high altitudes, where the atmospheric density is much lower than at sea level, the correction factor for horse power would assume a very large value and that for specific fuel consumption also would become appreciable; but tests are usually made under atmospheric conditions which approach those at sea level rather closely.—P. M. H.

Butane as Motor Fuel

Editor, Automotive Industries:

I feel that some factor or other which has not yet been recognized is the cause for certain poor mileage results which have been reported on vehicles using butane as fuel. For example, tests are at present being made in Los Angeles on two trucks which have been running on butane for about two years, one of which is doing very much better mileage than the other, although they are identical trucks in identical service. We are trying to find out just what it is that is causing the difference in economy. Certainly it is not due to the butane carburetors, because they have been interchanged without in any way affecting the results.

We can produce letters from numerous operators who testify that they get better mileage than with gasoline, even where the gasoline carburetors were very carefully adjusted. Right at present we are testing butane against gasoline on a number of Studebaker semi-trailers and are getting about 10 per cent more miles per gallon on butane than on gasoline. These trucks were delivered in one batch, new, from the factory about the end of February, and have, we presume, the very latest thing in gasoline carburetors.

We recently equipped a fleet of 30 new Mack trucks in Los Angeles for use on the Cajalco Dam construction, but have unfortunately not been able to make a comparison with gasoline operated trucks because they are not using gasoline on any of them. However, we may say that the consumption of butane in gallons per shift is considerably less than that calculated on the assumption that gasoline would be used. These trucks have Mack CF engines.

I do not agree that any of the various small difficulties are necessarily characteristic of butane operation. There is nothing in butane likely to cause difficulties, although the butane is never made to specifications nearly as stringent as those adopted for gasoline. We have often had to use butane that contained impurities that would not for a moment be tolerated in the cheapest gasoline. The composition of the mixture of propane and butane usually varies greatly with every batch and contains excessive quantities of ethane, methane, dirt, sulphur, absorption oil—in fact, almost anything that can conveniently be collected in the average refinery.

For butane is usually regarded as "waste material" and until recently ranked about level with acid sludge as an unwanted child of the oil industry. In spite of all these hindrances, we have been able to produce butane carburetors that defy the worst efforts of the refinery engineers.

Some mention has been made of preignition. This is due to the high compression employed and can be avoided by the use of cooler spark plugs.

Detonation occurs, of course, when the compression is raised sufficiently, but the anti-knock value of the fuels is far better than that of the best gasoline. Here are approximate figures:

Normal butane.......	90% octane
Iso-butane	115%
Propane	125%

I should like to say a word regarding pitting of the exhaust valves. This is due to the employment of weak mixtures used to obtain good fuel economy. Needless to say, it does not pay to use weak mixtures on full throttle operation, for this very reason, but as soon as the manifold pressure rises to about 2 pounds, the more economical mixtures may be used. These are provided for in the design of our carburetor, by the action of our economizer, by the use of which we often get considerably better economy than is possible with the weaker mixtures, besides avoiding burning of the valves and obtaining full power. (It will, of course, be understood that the amount of benefit obtained with an economizer depends largely upon the conditions of service, and the amount of full or partial throttle operation).

We know one operator in particular who is using large Waukesha motors who runs his engines well over 100,000 miles without regrinding either his valves or his cylinders. With correct butane-air mixtures, valves seem to be absolutely unaffected.

Admittedly, we still have a lot to learn about butane and its carburetion, but I insist that it is a fuel infinitely superior, in every way, to gasoline. I still maintain that it has as many, or more, miles per gallon to it than gasoline.

G. L. HOLZAPFEL.

Headlight Design Lags

Editor, AUTOMOTIVE INDUSTRIES:

"The youths stated that they were blinded by the light of a car coming toward them and were unable to see .... as he was walking along the side of the road. The boys were not held."

If the automobile headlight design had kept pace with the rest of the progress in auto design and performance we would not see so many news items today similar to that above.

What alibi can the automobile and headlight manufacturers offer in defense of the present inadequate and extremely dangerous lighting scheme? Well-meaning engineers advise us how to drive against the present headlight glare but it just can't be done. It is just good luck that a driver avoids a mishap with the blinding glare of lights coming toward him, and a blinding reflection from the rear through the rearview mirror, both destroying the driver's ability to see the road ahead and causing involuntary blind driving.

The various driving and passing light combinations in use today are not the answers. Many drivers are courteous enough to dim their lights but the percentage who do not is dangerously close to the 100 per cent mark.

If the vast spread of light in all directions now prevailing was concentrated on the road proper, night driving would not be the nightmare that it is.

Under present conditions dimmed lights and an added driving or spotlight is the only safe driving combination. Why cannot the manufacturers equip their cars with lights which will not prevent the driver facing them from seeing distinctly where he is going and what he is approaching at all times?

Why wait for the illuminated highways of the distant future or until the toll becomes so great that a multitude of conflicting laws complicate the situation?

How about a fixed combination with the left headlight concentrating all rays below the horizontal and the right headlight concentrating all rays to the right of a line parallel with the center of the road? Certainly there must be some way to take the dangerous glare out of the present day headlights.

Yours truly,
L. L. CASS.

In a Later Letter

I have read with great interest a "Just Among Ourselves" page wherein adverse criticism is made of Mr. Roper's speech at the Accident Prevention Conference.

The general nature of your business naturally causes you to defend the automobile manufacturer, but if you knew the facts as I do, and apparently Mr. Roper's advisers know them, you would readily admit that the manufacturers can do much to reduce accidents and still return a handsome profit to their stockholders without losing any business because of a very slight increase in prices.

Outside of the second question under "Leading Questions Seem Unfair," they are far from being unfair.

I will grant you that the greatest number of accidents can be eliminated by education and more strict enforcement of sensible laws, but any lives the manufacturer can save are of far greater value than any increase which may be necessary in the price to the user.

Consider the headlights, have you ever tried to drive against a long line of cars at night? I have more or less, for 20 years, and I am only one of thousands who are hoping that some day we can really enjoy night driving, unless our existence might be ended before then through one of the frequent accidents due to headlight glare. This is the most serious deficiency in the present day car and most certainly can be remedied if the manufacturers only will.

The light car manufacturers are ef-

(Turn to page 918, please)

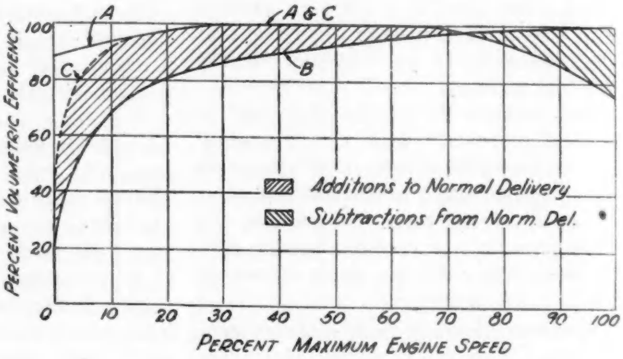
Body and Engine Designing,

High-Speed Diesel Control

GOVERNING systems of high-speed Diesel engines were discussed in a paper at the S.A.E. Summer Meeting by C. R. Alden, research engineer of Ex-Cell-O Aircraft & Tool Corp., with special reference to the governing equipment of the Ex-Cell-O injection pump. In this pump the central rotary valve performs a function very similar to that of the breaker cam of the modern ignition unit, insofar as an advance in the phase relation of the rotary valve results in an advance in the start of injection. Referring to Fig. 1, governor weights 9 give endwise motion to a fuel quantity-control pin 10 which moves the central rotary valve 7 axially, thereby controlling the quantity of fuel in accordance with the engine speed. The flyballs can be of small size, as they are required only to handle the driving torque of the rotary valve, which is very slight.

On the same shaft which carries the fuel quantity-control governor weights 9 there is another pair of governor weights 14, which control the timing. Movement of these weights on their pins gives axial motion to a helically-slotted member 15, which changes the phase relation between the rotor driving shaft 16 and the main shaft of the pump. Radial movement of weights 14 is opposed by a spring 12 which acts through the arm 18. This timing-control arm 19 is provided with a cam 19, for a purpose which will be explained later.

Fig. 2—Curves of volumetric efficiency and fuel quantity vs. speed

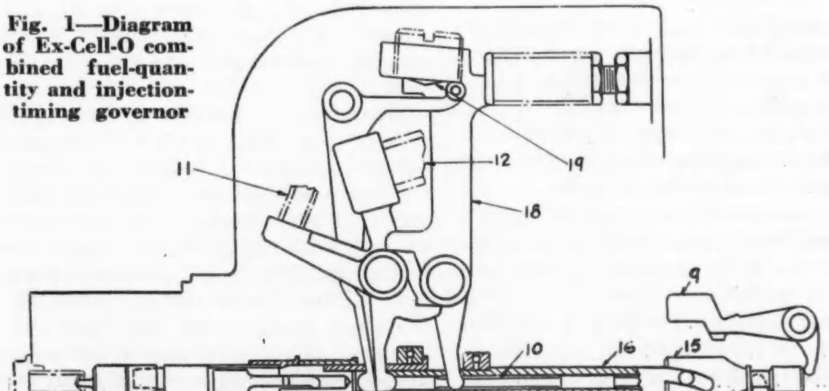


A, typical curve of engine volumetric efficiency; B, typical uncorrected curve of normal fuel-pump delivery; C, curve of fuel-pump delivery as corrected by interaction of fuel-quantity control and timing-control governors.

There are thus two governing elements responsive to engine speed, one of which directly controls the fuel quantity and is highly sensitive to speed variations, thus enabling it to give close speed regulation. In cases where a wide range of governed speeds is desirable, as in bus, truck and tractor service, the pressure of the high-speed-governor spring may be varied at will. In contrast to the quantity-control or speed governor, which is responsive to only a narrow range of speeds, the timing governor is responsive to a much wider range of speeds. Compounding of springs and composite helices on the axially moving cam which controls the phase of the central rotary valve, provide a wide choice of timing curves.

It is known from volumetric efficiency curves that the amount of air drawn in by an engine for a given throttle setting decreases as the speed of the engine increases. Fuel injection pumps, on the other hand, have a tendency to increase the delivery per stroke with an increase in speed, over the normal operating range of speed. Thus air quantity and fuel quantity are oppositely affected by a change in speed. Fig. 2 is a curve of theoretical pump displacement as affected by operating speeds. The theoretical quantity, as indicated, is decreased by internal pump leakage, which varies considerably with speed, temperature and viscosity of fuel, and is aggravated by wear of the pump elements. It is evident that this leakage becomes a matter of increasing seriousness at low speeds, so that an automatic correction at cranking and idling speeds is highly desir-

Fig. 1—Diagram of Ex-Cell-O combined fuel-quantity and injection-timing governor



, Vibration, Lubrication, Fuels

Out of the papers presented at the S. A. E. Summer Meeting many new ideas and developments are reflected.

able. In the Ex-Cello-O pump, the desired object is accomplished by interaction between the two governor elements referred to in the foregoing.

Timing control arm 18 (Fig. 1) carries the cam 19 which determines or limits the forward movement of the rotor toward a position of increased fuel delivery, thus limiting the maximum quantity of fuel which can be delivered by the pump. Any desired curve of fuel quantity vs. speed may thus be obtained by suitably shaping cam 19. The governing mechanism comprises an idling spring 11 whose pressure determines the speed at which the engine will idle, and also a variable high-speed spring 12, with linkage, whose pressure determines the speed at which the fuel quantity is governed.

In engines of the fuel-injection, spark-ignition type, as exemplified by the Waukesha Hesselman, the quantity of fuel injected must be made responsive to the density of the air in the inlet manifold—in other words, to the inlet vacuum. The governing mechanism shown in Fig. 1 can be readily modified so that the quantity injected is made dependent on the inlet vacuum instead of on engine speed. If that is done, automatic injection-timing control may be retained, as may also the feature of automatic limitation of maximum fuel quantity at any particular speed by the inter-action of the two governor elements.

Pneumatic governors for Diesels have come into prominence recently, and are particularly advantageous in being able to maintain close speed regulation at idling speeds, in which speed range the centrifugal governor is at a disadvantage. However, the reverse also holds, and at high speeds it is usually impossible to secure with pneumatic governors the same close speed regulation which is possible with the centrifugal type.

Constant-Speed Propeller

AUTOMATIC propeller operation has long been regarded as an ideal by airplane builders and operators, said F. W. Caldwell, E. Martin and T. B. Rhines in a paper on "The Constant-Speed Propeller." In recent years several types of controllable-pitch propellers have been produced, while other developments include propellers that provide for automatic response to various forces acting on the blades themselves, or to forces from outside the propeller. It has become apparent that the most satisfactory type of operation is that which matches the propeller operating conditions to the limits established for the engine on which it is mounted. This means, essentially, that the engine speed should be held constant at any desired value regardless of the altitude or attitude of the plane.

Manual control is open to serious objections. In military work, for instance, it would mean a continuous effort on the part of the pilot to maintain the rated engine speed during manoeuvres.

Automatic propellers have been designed to be responsive to the engine and propeller torque. This type is usually arranged so that a given engine torque is always associated with a corresponding engine speed, and a decrease in torque will yield an increase in revolutions. Such operation is satisfactory for various airplane speeds at one altitude; the flight condition can be changed from that for maximum speed to that for climb without appreciable variation in the engine condition. The effect of varying density, above the critical altitude of the engine, is such that the torque increases and, as a result, the engine speed drops. It is apparent that this effect will seriously limit the airplane performance at high altitudes, where a more satisfactory propeller would maintain constant engine conditions.

Propellers which are responsive to thrust are in somewhat the same class. They may be arranged to cause a reduction in blade angle as the airplane speed is reduced, but the decrease in thrust which accompanies an increase in altitude will allow the blade angles to increase and thereby cause serious reductions in engine power. Here again the climb at high altitudes and the ceiling may be inferior even to those which can be obtained with fixed-pitch propellers.

Another system of design endeavors to make the propeller pitch responsive to air density or atmospheric pressure by means of manometric capsules and other devices. Such a system is open to the objection that it does not provide for pitch adjustments needed for take-off and climb. It also operates in an unfavorable manner at altitudes above the critical altitude of the engine.

These examples emphasize the point that full advantage of the engine output can be taken only when the propeller operation is arbitrarily arranged to correspond with the manner of rating the engine. The full power output which may be taken from an engine in a climb is to be had only when that engine is run at its rated speed. Thus far, no means has been found whereby the forces from the air on the propeller blades will actuate the blades to maintain this desired constant speed under all conditions. Even if this were to be accomplished, some control should still be left with the pilot in order that various speed ranges could arbitrarily be chosen; the engine speed for cruising differs from that for climb. As long as such an arbitrary type of operation is desired, an arbitrary mechanism must be used. This mechanism may most easily be a governor which operates entirely independently of any forces on the propeller and is affected only by the speed at which the propeller turns. Such governors can, of course, be made controllable so that any desired operating speed within their range can be chosen.

The Hamilton Standard constant-speed propeller has been developed to meet the above operating requirements. The equipment consists essentially of the well-known Hamilton Standard hydro-controllable propeller with the addition of a conventional centrifugal governor connected to the engine and controlling the supply of oil to the actuating piston on the propeller hub. In present propellers, a blade angle range of 20 deg. is available. This range is sufficient to allow the engine to be operated at its rated limits from the start of the take-off through the cruising glide. In addition to the automatic constant-speed feature, provision is made so that the propeller may be put in positive high or low pitch, in which case it will act in the same manner as any other constant-angle propeller. The sensitivity of the governor is such that the engine speed may be held within sufficiently close limits to allow the control to be used for synchronizing engines on multi-engine airplanes.

Reaction to Vibrations

WORK on instrumentation for the determination of automobile riding qualities has been in progress at Purdue University for some years, and what might be regarded as a progress report was made by Prof. H. M. Jacklin in a paper on "Human Reactions to Vibrations."

The project developed naturally into four parts. The first was concerned with the reactions of humans to rectilinear vibration and was developed by the use of a vibrating platform or "shake table." The second phase had to do with the development of an instrument whereby accurate records might be obtained of the concurrent forces existing in vehicles, these forces acting upon the passenger and influencing the character of the ride. The third part was the most difficult, in that it involved the interpretation of a considerable amount of data from records obtained with many subjects in many vehicles on several types of road surfaces. The fourth part has to do with the application of these results in comparing vehicles and equipment.

From tests on a large number of individuals with the Purdue "shake table" (described in an earlier issue of AUTOMOTIVE INDUSTRIES), what might be called a discomfort factor, *K*, was determined which was found to be related to the maximum acceleration, *A*, in ft./sec.^{2} and the frequency, *f*, of the vibration in cycles per second by the equation

$$K = A e^{.0f},$$

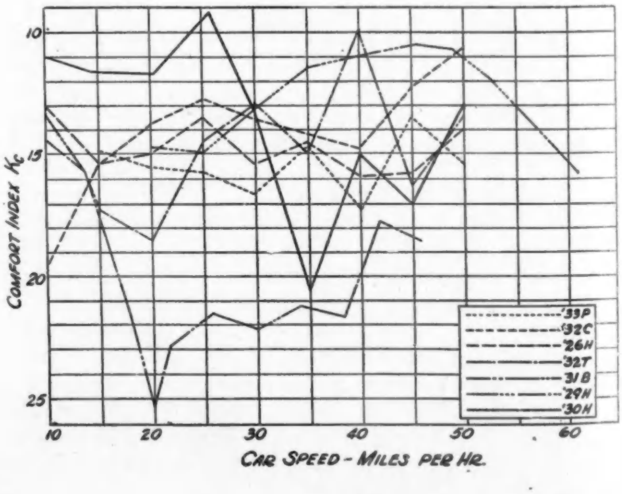
where *e* is the base of the Naperian system of logarithms (2.718). Studies of several hundred individual tests gave the following values for *K*:

Event	Direction	K.
Uncomfortable	Vertical	64.7
Disturbing	"	31.2
Uncomfortable	Longitudinal	11.73
Disturbing	"	4.02
Uncomfortable	Transverse	8.21
Disturbing	"	2.35

The above results are directly applicable to the reactions of humans sitting upon rattan-covered street-car seats, which is the type of seat used in the tests.

Studies of the results obtained with the "shake table" led to the selection of a "control group," consisting of about 35 people, for studies in cars on the road, the reactions of these 35 being consistently within ± 10 per cent of the averages. Test rides were taken by this control group in a dozen different cars. The Purdue accelerometer was mounted in a dummy and the assembly set on the left rear seat, with the control subject alongside of it. On a selected road section the speed was increased until the subject observed a disturbing reaction, when an accelerometer reading was taken. The accelerometer records show three wave forms, representing vertical, transverse and longitudinal accelerations respectively, and an additional straight line shows time in increments of 1/10 sec. Later on other similar test results were added and all of the data were reanalyzed. Equations were now derived for the disturbance and the discomfort factors for all three directions of motion. By combining these three factors to give the vector sum of the forces at zero frequency, a figure was found for the maximum acceleration which a human will sustain before he is disturbed or rendered uncomfortable. The disturbing acceleration was found to be 9.78 ft. per sec.^{2} and the discomfort acceleration 11.9 ft. per sec.^{2} It is understood that the disturbing factor is similar to the acceleration used in modern high-speed passenger elevators in tall buildings.

Prof. Jacklin stated that the accelerometer proved itself very reliable in all of these tests. The accelerations and frequencies can be determined by simple methods, and nomographs attached



Values for Kc for seven cars built from 1926 to 1933

to the paper make an analysis of the records quick and easy.

The index of riding quality, K_c, was determined for 14 different automobiles and in tests of new seat materials. The accelerometer being placed in the left rear seat, the vehicle was driven over a section of level concrete road so that the left wheels passed over a standard obstruction, made of steel, 12 in. long and representing a ramp rising to 2 in. at the far end. The values of K_c obtained from the records ranged from 4 to over 20 for representative cars, so that both the disturbance and discomfort points were covered. Tests were made at speeds increasing in steps of 5 m.p.h. from 10 to 60 m.p.h. A set of tests for one car over this speed range is obtained in not over one hour under ordinary conditions. After developing the records, the analysis can usually be made in from 3 to 6 hrs., so the time element is not excessive. The drawing reproduced herewith shows the results of tests on car models ranging from 1926 to 1933 (as indicated by the numbers on the curves). The earlier models were of the eight-cylinder type, while the '32 and '33 models were six-cylinder cars. The lower the discomfort factor (and therefore the higher the curve), the better the riding qualities of the car. The results are said to agree with the personal observations of people who rode in them.

The Future Car

TALKING on "The Car of the Future" at the opening session of the S.A.E. Summer Meeting, Walter T. Fishleigh, consulting engineer of Detroit, said the slower the sales the greater the efforts made to improve designs and create new ones, and from that point of view the depression had had a beneficial effect. Many had urged the industry to try radical experiments, but he felt that these were no safe substitutes for scientific development and sound engineering evolution. The paper by Mr. Fishleigh and his brother Clarence was prepared on behalf of the passenger car activity of the society, which is understood to concur in the ideas promulgated by the authors.

It was pointed out in the paper that the "style eye" of the public can be changed only slowly and also that a radical change in the control of a car model from one year to the next is disconcerting, if not dangerous. It is just as dangerous to be too far ahead of the public as to be too far behind. Moreover, in our country, with its mass production programs, automotive progress and development will never come by abstract conjecture or detached radicalism, it must come by studied judgment based upon scientific training, experience and tests, and upon an analysis of public demand.

Going into details, Mr. Fishleigh predicted that powerplants would attain still higher weight efficiency and be made more compact so as to leave more room for passengers. More use would be made of superchargers.

Such major changes as moving the engine to the rear can be made successfully only under some kind of emergency conditions, as when sales (of a particular company) are failing, a new company attempts to enter the field against strongly intrenched competition, or a new model is being developed to enter a new price class. After listing some of the pros and cons of the rear-engined car, the authors summed up their views on the subject by saying this type of car would not be accepted by the public until it had been developed to the point where it was demonstrably superior to the present type in comfort, convenience, fuel economy and eye appeal.

Overdrives have definite advantages and will be adopted more widely; in 1940 their use may be general except in the lowest price class. As regards the automatic transmission, the view was expressed that the public wants effortless rather than automatic control, many drivers actually deriving definite enjoyment from the operation of manual controls.

Rear wheel enclosures are here to stay and considerable improvement in their design may be expected for 1937. Unit-body-and-frame construction is here, and while it involves production difficulties which have not yet been fully solved and eliminates convertible body types as a production proposition, a gradual increase in its use may be expected. It will be a logical feature of rear-engine models when they come.

With lower floors, wider bodies, enclosed front wheels, and a guard rail around the bottom edge, running boards will be discarded, but some provisions must then be made to protect the body against "throw-off" from the wheels. Enclosure of the under side of the body will reduce air resistance by as much as 15 per cent. Rear-engined cars would lend themselves readily to such enclosures, but in the case of front-engined cars the problem of heat disposal would present difficulties.

In the authors' opinion, streamlining, although still in its infancy, has had a rather sad history so far, due to disregard of esthetic requirements by the sponsors of streamlined automobiles. However, streamlining and esthetic requirements are not incompatible. It is quite possible to combine the former with symmetry, style and beauty and still achieve a reduction of 50 per cent in the air resistance, as compared with present-day conventional cars.

S. J. ZAND of Sperry Gyroscope Co., Inc., also contributed to the symposium on "Noise Treatment." The burden of his argument was that instead of trying to quiet cars by profuse applications of sound-absorbing material, efforts should be made first to locate the various sources of noise and try to reduce the causes of the noisy operation in each case. Only when all resources along this line had been exhausted should recourse be had to absorbing material.

Survey of Air Transport

COMMERCIAL air transportation in the United States is observing its tenth birthday this year, said W. A. Patterson, president of United Air Lines, in "A Survey of Air Transportation." It was in the spring of 1926 that the first air mail-passenger operations under private management were inaugurated. However, the real growth has been confined to the last five years, which by a coincidence have been the depression years. The following figures prove that:

	1930	1935
Passenger-miles flown by all U. S. air lines	95,000,000	313,410,560
Mail pound-miles (on domestic lines)	7,000,000	13,276,023
Express	143 tons	1,907 tons

This substantial growth of air transportation is encouraging. But, with this expansion have come pressing problems of management, operation, finance, public relations, sales policies, changed relationships with municipal, state and federal governments, and other problems which must be faced intelligently if air transportation is to progress.

The growth of passenger business has attracted the most attention, but income from air mail and express is essential to the air lines. While air mail in 1929 constituted 95 per cent of the air lines' income, it represented only 36 per cent of air line operators' average income per mile in 1935, despite the fact that the lines carrying the larger portion of the air mail are flying 35 per cent more poundage than ever before, at a rate of pay per pound-mile substantially less than formerly.

The public should realize that certain air transport companies are no longer in the subsidy class as regards air mail. The gap between the amount of money the Post Office Department receives in postage from air mail and the appropriation for its transportation is being closed. In March, the Postmaster General stated that air mail postage revenues for the last fiscal year amounted to $6,589,534 and the total direct cost of the air mail service to the Post Office Department was $9,588,905.

Among the topics discussed by Mr. Patterson were mail-carrying rates, obsolescence of equipment, joint experimental development, safety of air travel, pilots' qualifications, and advantages of air travel for business men and holiday seekers.

Liquid-Cooled Air Engines

IN contrast to the United States, where there is a great preponderance of air-cooled engines used mainly in civil aviation, in England, where civil aviation is comparatively small and most engines and aircraft are made for the British Air Ministry for military purposes, a balance has been maintained between the liquid-cooled and air-cooled types of engine, according to H. Wood of Rolls-Royce, Derby, England, who presented a paper at the SAE Summer Meeting on Liquid-Cooled Aero Engines.

Until recently no great refinement in cooling drag was required, but now that performances are improving, views regarding the whole engine and aircraft problem must be revised, and Mr. Wood in his paper presented some of his views on the subject. In the first section of his paper he described the Rolls-Royce Kestrel engine which has been in production for eight years. It is a 12-cylinder 60-deg. V engine of 5 in. bore and 5.5 in. stroke, and one of its characteristics is its small frontal area. To meet the varying requirements of naval and military authorities the present series is made in three main varieties, each available with one or the other of three reduction gear ratios: 0.632, 0.553, 0.477. Progress in the development of the Kestrel engine since 1928 was shown in a series of charts from which the following figures for the original and the latest types of fully supercharged models are taken:

	1928	1936
Lb. max. horse power	1.75	1.30
Lb. normal sea-level power...	1.95	1.50
Max. b.m.e.p.	128	152
Norm. sea-level b.m.e.p......	120	146
Compression ratio	6	6
Max. r.p.m.	2500	3000
Normal r.p.m.	2250	2600
Time between overhauls (hrs.)	300	400

At the present time the Rolls-Royce firm has another engine under development, the Merlin, a fully-supercharged type designed for high-temperature liquid cooling. The cooling medium is ethylene glycol and the outlet temperatures are 230 and 266 deg. F. This is a 12-cylinder V engine of 5.40-in. bore and 6-in. stroke (1647 cu. in. displacement); it is fitted with a reduction gear giving a reduction of 1/0.477, and with a supercharger having a gear ratio of 8.59/1. For operation on 87-octane fuel it is fitted with pistons giving a compression ratio of 6:1.

Discussing the military aircraft engine of the future, Mr. Wood expressed the opinion that by 1940, engines would be built in units of at least 1600 hp. A table was incorporated in the paper which gave the cylinder dimensions for such an engine for both short-stroke or square engines (1:1) and long-stroke (1.2:1) engines, based on a piston speed of 3000 ft. per min. and a m.e.p. of 170 lb. per sq. in. Engines of from 9 to 30 cylinders were included. It was pointed out by the author that for such engines the hp. per sq. in. of piston area would be 3.86 throughout, and the rate of heat rejection also would be constant, 7.60 C.H.Us. per sq. in. per min. The specific weight in lb. per hp. would vary inversely as the square root of the number of cylinders, but the weight of the supercharger and reduction gear, which are independent of the number of cylinders, would not vary with a change in the latter.

Comparing glycol high-temperature cooling with water cooling, the author said the difference in boost pressure and power output was negligible, the specific fuel consumption was always slightly less with glycol cooling, the heat flow to the jackets was of the order of 44 per cent of the b.hp. equivalent with glycol cooling and 54 per cent with water cooling, and that the heat absorbed by the lubricating oil amounted to 4 per cent of the b.hp.-equivalent with glycol cooling and 2 per cent with water cooling.

Considerable work was done on evaporative cooling systems, both on the engine and on aircraft. Unfortunately, in high-performance aircraft the sur-

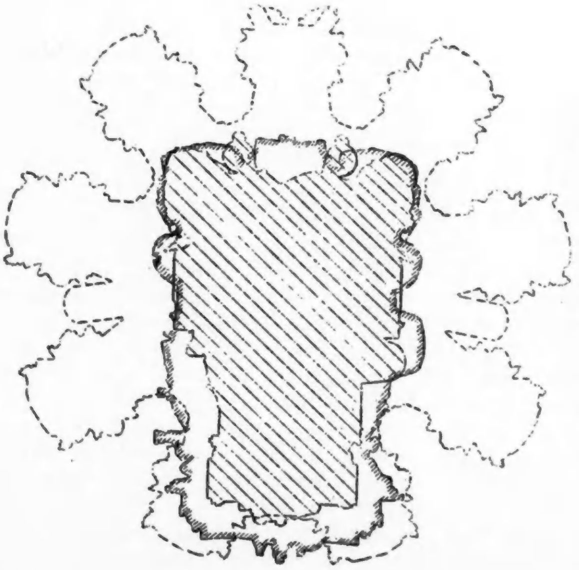


Fig. 1—Comparison of frontal areas of radial air-cooled and two designs of water-cooled aircraft engines

Diagram shows outlines of frontal elevations of (1) a nine-cylinder radial air-cooled engine of 1750 cu. in. displacement, with frontal area of 1778 sq. in.; (2) Kestrel 12-cylinder V engine of 1298 cu. in. displacement and 643 sq. in. frontal area, and (3) Merlin 2-cylinder V engine of 1645 cu. in. displacement and 842 sq. in. frontal area.

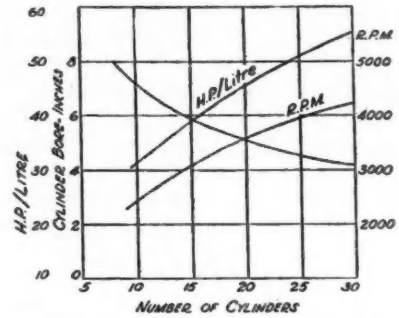


Fig. 2—Relation between cylinder number, cylinder dimensions, speed and specific output for an engine of 1600 hp. for a piston speed of 3,000 ft.p.m. a b.m.e.p. of 170 lb. per sq. in. and a stroke: bore ratio of 1:1

face available for cooling is seriously restricted, and there are difficulties in returning the condensate to the system. There is practically no benefit to cooling drag if the steam is condensed in a conventional honeycomb radiator. In view of these restrictions the author's firm has concentrated on high-temperature cooling with conventional radiators efficiently cowled.

Owing to limitations of materials available and foundry technique, cast cylinder heads are always considerably heavier than they need be from the standpoint of mechanical strength. For this reason the author's firm has under consideration two methods not involving the use of castings and which offer considerable advantages over them. The most sucessful British air-cooled engine for some time has had its cylinder heads made from forgings. Modern machining methods, made possible by large-scale production, enable every square inch of the surface to be machined, at a cost which compares favorably with that of the cast head which it replaced. In addition, the cooling surface and valve ports, being fully machined, are what the designer intended them to be, with considerable benefit to cooling and valving, respectively. With liquid-cooled engines the problem is necessarily somewhat more difficult, as an enclosure has to be formed to hold the coolant.

At the Rolls-Royce plant investigations on the harmful effects of detonation are made on the basis of audible knock of constant intensity, and these observations are confirmed periodically by tests to destruction. At present detonation tests are usually made with two mixture strengths, viz., that corresponding to maximum economy, which is used for cruising, and that corresponding to maximum power, which is used for take-off and maximum performance. The actual mixture strength used in the last-mentioned test depends on the combustion, chamber form and the operating conditions. Sometimes an increase in specific consumption above a certain point on the rich side will cause increased detonation, though generally the reverse effect is obtained. Some tests made with 100-octane fuel in the Kestrel engine encouraged the belief that the liquid cooled engine has a great future on high-octane fuel.

The effect of cylinder size on detonation has been ascertained and a scale-down in size of from 6.0 in. bore to 5.0 in. bore has enabled the head to be run at 10 per cent higher m.e.p. When a scale-down is made, the beneficial effects of reduced flame travel and combustion time are likely to be overshadowed by the changes in cooling efficiency which take place. For example, with a cast head, the smaller cylinders may make some of the water spaces so small that the cores become impracticable. Providing the coolant (liquid or air) passages can be scaled down, the smaller cylinder will undoubtedly score from a cooling standpoint. The heat paths—particularly from the piston—are shorter, and the general reduction in metal thickness reduces temperature stresses, enabling the unit not only to run at a higher m.e.p. free from detonation, but also to carry the consequent higher pressures.

When detonation occurs, thermocouples disposed around the inner surface of a Kestrel cylinder show rises in temperature of not more than 36 deg. F., except in very extreme cases. Tests with cathode-ray engine indicators show no extreme pressure due to detonation, but only changes in the rate of pressure rise, and it would seem, therefore, that detonation attack can be due neither to temperature nor to pressure. There was found to be a similar difference in resistance to attack between cast and forged materials. This discovery led to an investigation of the effects of surface treatment to resist attack, and an exploration of the available materials from the standpoint of low susceptibility to attack. It is claimed to be a point in favor of the liquid-cooled engine that it can run detonating for considerably longer periods than the air-cooled types, as head temperatures are more nearly stabilized.

Aircraft Engine Lubrication

AIRCRAFT engine lubricating systems were reviewed at the SAE Summer Meeting in a paper by A. L. Beall, research engineer of Wright Aeronautical Corporation, the title of his paper being "A Brief Analysis of the Automotive Lubrication System." While the discussion of lubrication requirements applied to high-speed internal combustion engines in general, practically all of the examples given were drawn from the aircraft field. It was held by the author that no small part of the success of individual lubricating systems is dependent upon refinements in design intended to (a) supply additional oil to surfaces critically loaded or at high temperature; (b) cool the oil in the crankcase or prior to its return to the main storage tank; and (c) separate precipitants or sludge from the supply to the bearings. One such refinement mentioned by the author is the rifle-drilled connecting rod designed to carry oil under pressure to the piston-pin bearing, which the author thought had a beneficial effect also on lubrication of the crankpin bearing in that the inertia head on the oil in the rod tends to prevent deficiencies in the supply to the rod bearing.

Another such refinement, illustrated in Fig. 1, consists of a small reservoir groove employed in a radial aircraft engine master rod bearing designed to supplement the discharge from the crankpin during the interval between registration of the crankpin discharge with the highly-loaded surface of the master-rod bearing. It is expected that the transition from full fluid film to border line lubrication is delayed or prevented by the supply from the reservoir groove under critical load or supply conditions.

Fig. 2 illustrates a device used in the same engine, designed to remove for-

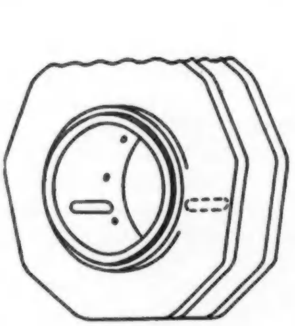


Fig. 1—Oil groove serving as oil reservoir in bearing of master connecting rod

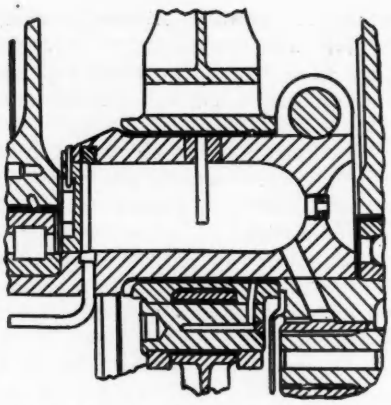


Fig. 2—Reservoir for foreign material in crankpin of radial aircraft engine

eign matter and sludge from the oil entering the master-rod bearing. It is a tube extending from the center of the crankpin to the pin surface, where the oil is discharged, and at the moderate rotational speeds of regular operation with such engines is a very effective centrifuge. The generous reservoir within the crankpin collects material too heavy to discharge through the tube, whence it can be removed at overhaul. This device obviously would not be suited to automobile engines, owing to the normally long intervals between overhauls. No matter how generous the reservoir for foreign material it might fill up before it became necessary to remove the crankshaft for other reasons.

Oil is generally introduced into the bearing at the unloaded side. The degree of crank angle selected for the discharge, the angle of incidence at the surface of the oil film, flats or grooves in the crankpin, grooves in the bearings, and the number of discharge holes in the crankpin all tend to complicate the problem.

Despite the efforts lavished on the lubricating system with the object of maintaining a full fluid film on the surfaces, it is obvious that there is much boundary-layer lubrication; it exists practically always for the top piston rings, and a larger proportion of the time than is generally believed, for the crank-assembly bearings.

While the main body of the aircraft engine oil is kept relatively cool, the total supply is relatively smaller than in an automobile engine (about one quart for 13 hp. delivered at cruising power, as compared with one quart for 8 hp. in the automobile engine). Recent information leads to the conclusion that there is generally less sludge formation in the aircraft engine. The larger volume of piston blowby per unit of crankcase volume, and conversely the larger automobile crankcase for a given piston blowby, plus the oxygen introduced by the crankcase breather, tends to produce more sludge per unit of service time in the automobile engine. For engines in good condition the piston blowby per horsepower developed does not vary greatly.

Mr. Beall thought it safe to predict the adoption of larger oil-storage reservoirs for automobile engines, either inside the crankcase or out of it, with thermostatic control of the volume of oil in circulation in the engine. By this means the oil in the bearings might be maintained at a uniform temperature regardless of seasons and operating conditions. As long as we keep on using lubricants of the type at present available, there is hardly any more important problem than that of maintaining uniform the temperature of the oil as it enters the bearings. The type of temperature control selected would determine how much the volume of oil carried would have to be increased.

High-Octane Blending Agent

IN a paper at the SAE Summer Meeting on "A New High-Octane Blending Agent," H. E. Buc and E. E. Aldrin of Standard Oil Development Company said petroleum chemists had long been seeking new materials suitable as high anti-knock fuels by themselves or as blending agents in the preparation of base stocks to which some anti-knock compound such as tetraethyl lead could be added in small quantities to give the desired high anti-knock value. Technical iso-octane is one such material already commercially available. A new material to supplement technical iso-octane has now been made available in isopropyl ether. In contrast to ethyl ether, which is a violent knock inducer, isopropyl ether, along with some other ethers, has been found to be an exceptionally good anti-knock fuel. Full scale multi-cylinder engine tests are said to have demonstrated its remarkable anti-knock qualities, and in physical characteristics it apparently meets the requirements of military and commercial aviation fuel specifications when blended with aviation gasoline in proportions to give 100 octane with 3 cc. of lead tetraethyl per gallon.

The physical characteristics of isopropyl ether are shown in Table I, along with corresponding values for pure iso-octane and benzene. Although a low-boiling material, its vapor pressure is below the maximum allowed for aviation gasolines, and when blended therewith, the vapor pressures will be entirely suitable. Its freezing point is low, and thus it does not have this disadvantage of the benzene or benzol-blend fuels. The latent heat of vaporization, while lower than for benzene, is comparable with that for iso-octane and consequently the same maximum engine horsepower would be anticipated from considerations of mixture cooling effect, and no increase in tendency to cause carburetor icing due to excess refrigerating effect would be anticipated. The heating value on both a weight and volume basis is somewhat lower than for either iso-octane or benzene.

In considering the physical characteristics of aviation gasolines, the subject of water tolerance is of major importance. The existing specifications for water tolerance of aviation fuels require only that, when 80 milliliters of the fuel are shaken with 20 ml. of water at room temperature, the increase in volume of the water layer shall not exceed 2 ml. This requirement is directed against the use of alcohol blends from which the alcohol is usually easily separated by the addition of water. Isopropyl ether has only very slight solubility in water and the above water tolerance test usually shows no measurable increase in the water layer, even when concentrations of 40 per cent are used in blends with aviation gasoline.

Test results have shown that a blend containing 40 per cent of isopropyl ether deposits hardly twice as much water as a 40 per cent benzol blend, and ten times as much as the regular aviation gasoline. In two tests at minus 10 deg. F. on the isopropyl ether blend, in one of which the fuel contained an additional 0.5 per cent of methanol, it was found that, although the same volume of separation occurred in both cases (0.005 per cent), the separation occurred as ice in the absence of methanol and as liquid in the presence of methanol. The melting point of the ice was plus 25 deg. F., and the freezing point of the liquid, which was found to contain about 40 per cent of methanol, was minus 50 deg. F. It appears therefore that the tendency of the isopropyl ether to take up water is not an important handicap to its use in aviation fuels.

Another characteristic of major practical importance in determining the

Table I

Physical Characteristics of Pure Compounds

	Isopropyl Ether	Pure Iso-Octane	Benzene
Boiling Point, °F. at 760 m. m. of Hg. pressure	154 (153-158)	211	175
Density at 68°F (20°C/4°C)	0.725	0.691	0.878
Refractive Index at 68°F	1.3680	1.3921	1.5014
Freezing Point, °F	—125	—162	42
Viscosity, Centipoise at 68°F	0.322 (68°F)	0.543 (65°F)	0.647 (68°F)
Latent Heat of Vaporization, B.T.U./lb.	123	130	170
High Value of Heat of Combustion, B.T.U./lb.	16,900	20,580	17,650
Low value of Heat of Combustion, B.T.U./lb.	15,600	19,200	17,000
Low value of Heat of Combustion plus Latent Heat of Vaporization, B.T.U./gallon	95,100	111,400	125,700
Reid Vapor Pressure, lbs./sq. in. at 100°F*	5.3	2.2	3.2

* Reid vapor pressure determined on commercial products rather than C.P. compounds. In case of benzene, vapor pressure value is for commercial 90 per cent benzol.

acceptability of a fuel is its storage stability. Blends of isopropyl ether in aviation gasoline have low gum content by all the usual methods of test. With the addition of 1 to 2 milligrams of gasoline inhibitor per 100 ml., these blends also have satisfactory resistance to oxidation. The induction period determined at 212 deg. F. under oxygen pressure of 100 lb. per sq. in. exceeds seven hours. The best motor gasolines rarely have an induction period exceeding six hours.

A considerable amount of data are available in regard to the octane number and lead susceptibility of blends of isopropyl ether by various methods. A study of these results justifies the following conclusions in regard to performance in single-cylinder test engines:

(a) Blended in commercial aviation gasolines, a fuel of 100 Army octane is possible with 40 per cent of isopropyl ether without exceeding 3cc. of lead tetraethyl.

(b) The blending value of isopropyl ether is slightly superior to the blending value of technical iso-octane in unleaded blends, and also superior for any fixed amount of lead tetraethyl in the corresponding blends.

(c) When blended with 74-75 octane gasoline, and without exceeding 3 cc. of lead per gallon, an octane number of approximately 101-102 is the maximum possible when using technical iso-octane as a blending agent, whereas isopropyl ether will give at least 105 in concentrations of about 65 per cent or over.

(d) The amount of lead tetraethyl necessary to meet a given octane number is less for isopropyl ether than for technical iso-octane in blends containing the same percentage concentrations.

Although the isopropyl ether has less heat value than iso-octane, it is figured that the same mileage could be obtained from blends of the former as from the latter. Owing to the fact that the maximum Army octane number is about four points higher for the isopropyl ether blend, a higher compression ratio or possibly a greater supercharge boost could be used with the former, and thus its lower heat value compensated for. As regards availability, a recent survey of potential supplies of propylene, the raw material for making isopropyl ether, showed that in this country sufficient is available, exclusive of all normal demands for other purposes, to produce approximately 340,000,000 gallons of isopropyl ether annually, sufficient for 850,000,000 gallons of the blend, and in view of the fact that the total United States consumption of all grades of aviation gasoline in 1935 was estimated at only 88,500,000 gallons, this is more than sufficient to meet the entire requirements for 100 octane gasoline even in the event of a national emergency.

Effect of Displacer-Piston

RECENT tests conducted at Langley Memorial Aeronautical Laboratory (and discussed in a paper at the SAE Summer Meeting entitled "A Visual Study of Air Flow, Fuel Spray, and Flame Formation in a Displacer-Piston Compression-Ignition Engine," by A. M. Rothrock, National Advisory Committee for Aeronautics) have shown that a considerable improvement in the performance of the compression-ignition engine can be obtained by the use of a displacer piston. To observe the effects of the displacer piston on the air flow and the effects of the air flow on the fuel spray and flame formation, motion pictures were taken at the rate of 2200 per second of these phenomena in the combustion chamber of the N.A.C.A. combustion apparatus. This apparatus consists of a single-cylinder test engine which is operated under its own power for a single cycle. A vertical-disk combustion chamber was employed, the sides of which were formed by two 2½-in. glass windows. A single 0.020-in. injection nozzle was used, so that the effects of the air flow on the spray distribution could be easily visualized. By using "Schlieren" photography, the air flow, fuel injection, and flame formation were recorded simultaneously. When the motion pictures are projected the phenomena can be observed at 1/150 of their actual speed.

The results show that while the core of the fuel spray was not destroyed by the air movement, the direction of the spray was changed and the spray envelope was carried away by the moving air. The volume of the chamber reached by the combustion was considerably increased when the displacer piston was used. It was found that the air movement set up during the introduction of air into the cylinder could be controlled so as to materially aid the air flow set up during the last part of the compression stroke.

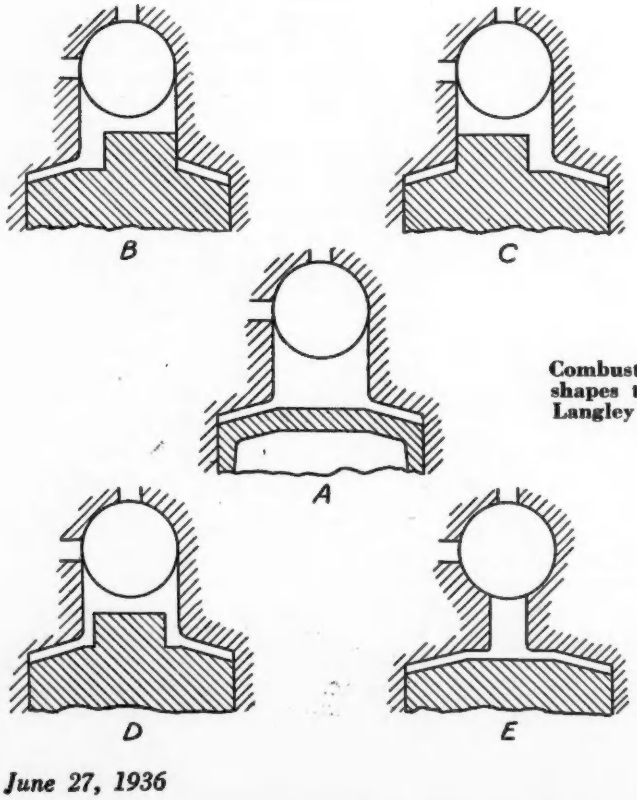
Five different forms of combustion chamber were experimented with, as shown in the drawing herewith. With form (A) the velocity of the air flow into the combustion chamber was naturally materially less than with any of the others. With the displacer located toward one side of the passage, it naturally produced air rotation in the combustion chamber, and the direction of this rotation depended upon which side of the passage the displacer was located in, so that in one position it aided the rotation of the air produced by the form of the inlet passages, while in the opposite location it opposed it. The analysis of the data obtained led to the following conclusions:

1. In the combustion chamber of the compression-ignition engine, air velocities as high as 300 ft. per sec. are not sufficient to destroy the core of a fuel spray from a round-hole orifice.

2. Air velocities of the magnitude given are sufficient to materially change the direction of the spray penetration and to blow aside the envelope of sprays from round-hole orifices.

3. In employing air flow in a combustion chamber, care must be taken that the motion of the air set up during the induction period is not such as to oppose the desired air flow produced at the end of the compression stroke.

Analysis of the results also suggested that the factor about which more should be known is the actual air/fuel ratio at each instant of the injection and combustion period. These ratios control the performance of the engine. It is already known that the air/fuel ratio is extremely uneven, and that, as a result, too much of the fuel is burned late in the expansion stroke, which means a low cycle efficiency. Not only must the combustion efficiency be improved, i. e., the percentage of the total fuel injected that is burned between the start of fuel injection and the completion of the power stroke increased, but the time at which this combustion occurs must be controlled to a greater extent than it is at present.



Combustion chamber shapes tested at the Langley Laboratory.

Propeller Vibration

THREE different kinds of free vibration of crankshaft-propeller systems were referred to in a paper by Karl Lürenbaum of the Deutsche Versuchsanstalt für Luftfahrt. These included the familiar torsional vibration of the crankshaft (as a result of which the crankshaft sometimes breaks close to the propeller hub, where there is a node); flexural or transverse vibration, and longitudinal or accordeon-type vibration. In addition, the propeller itself is capable of two forms of vibration, flexural and torsional. All five forms of vibration are illustrated diagrammatically in Fig. 1, in which L_k represents longitudinal vibration of the crankshaft; D_k, torsional vibration of the crankshaft; B_{k1} and B_{k2}, flexural vibration of the crankshaft; B_l, flexural vibration of the propeller, and D_l, torsional vibration of the propeller.

Flexural vibration of the crankshaft may result in fractures in wood and metal propellers. In metal (magnesium) propellers such fractures are confined to the blade root near the hub, where there is a concentration of stress due to the clamping effect of the hub. In wood propellers cracks appear in the metal rim, and the varnish peels at a definite point on the upper half of the blade, where there is a node of first-harmonic flexural vibration. Recently fatigue fractures have been observed in crankshafts which differ in appearance from those due to torsional vibration, and it is concluded that these fractures must be due to longitudinal or accordeon-type vibration of the crankshaft.

Tests on the resistance of crank throws to extension under axial forces are now being carried out at the Versuchsanstalt, and it is planned to develop a so-called reduction formula for longitudinal stiffness corresponding to the well-known reduction formula for the torsional stiffness of crank throws, which would permit of determining the natural frequency of longitudinal (accordeon-type) vibration in advance.

In crankshaft vibration only the fundamental or first-order vibration is of importance, as a rule, but in the case of propellers the higher orders of vibration must also be considered.

Apparatus for the direct measurement of the amplitude of torsional vibration of crankshafts is available (D.V.L. torsiograph), and vibration- or stress-measuring apparatus for propeller vibrations is now being developed. A provisional method has been developed for approximating the stresses of vibration in propeller blades.

The tendency toward increased power and speed in aircraft practice necessitates more effective means of reducing vibration. The problem can be attacked in three different ways, viz., by

1. Elimination of the sources of vibration;

2. Damping of the vibrating members, and

3. Moving the critical speeds outside the operating speed range.

The possibilities of the first method are extremely limited and were not discussed in the paper. Elimination of destructive vibration by the use of dampers is familiar through the example of torsional-vibration dampers. Use of such dampers results in an increase in weight, and their effectiveness is limited to particular types of vibration. The third method, consisting in a

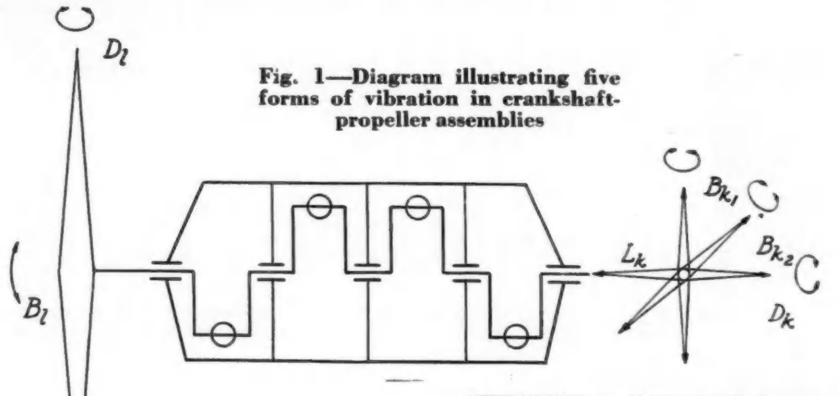


Fig. 1—Diagram illustrating five forms of vibration in crankshaft-propeller assemblies

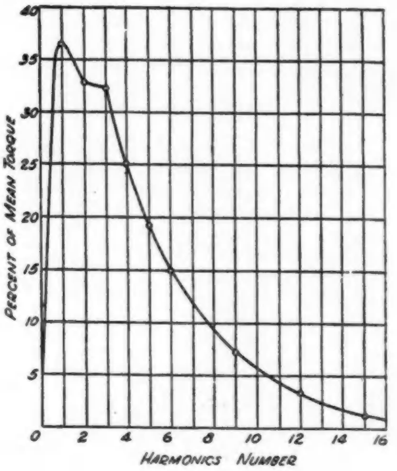


Fig. 2—Amplitude of torsional harmonics in per cents of mean crankshaft torque.

change of the natural frequency of the vibrating system, is considerably more promising and does not call for an increase in weight. Natural frequencies of vibrations of different forms in aircraft engines fall within the following ranges:

Torsional vibration of the first order, 4500 to 15,000 cycles per minute.

Longitudinal vibration of the first order, 6000 to 15,000 cycles per minute.

Flexural or transverse vibration, 23,000 to 30,000 cycles per minute.

By reference to Fig. 2 it can be seen that these frequency ranges coincide with the effective section of the frequency band of excitation for torsional harmonics, that is, the harmonics of low order and large exciting amplitude. Conditions for the production of critical speeds could hardly be more favorable, and the question arises as to whether a displacement of the natural frequency spectrum into a higher or lower frequency range seems promising.

In some recent experimental engines an attempt has been made to increase the natural frequency of torsional vibration, carrying it into the range of 12,000 to 18,000 cycles per minute, by making the crankshaft as rigid as possible torsionally, so it will come into resonance only with the higher torsional harmonics of relatively low exciting force. (Fig. 2). However, such rigid crankshafts involve a number of disadvantages, including increased weight, higher rubbing speeds and increased bearing troubles.

Owing to the fact that the frequency of torsional vibration of the crankshaft is largely dependent on the propeller mass rigidly joined to it, it has been proposed to interpose a flexible connection between crankshaft and propeller. With such a flexible connection only the mean torque of the crankshaft would be transmitted to the propeller. The frequency of first-order vibration of such a system would be so low that it would come into resonance with the lowest torsional harmonic below the operating speed range. Owing to the entirely different form of the free torsional vibration, approaching similar vibration amplitudes for all throws, there would be no low torsional moment of high amplitude except that of the order 2n/z, n being the r.p.m. of the engine and z the number of cylinders. However, a broad vibration-free zone should be provided within the operating-speed range, by suitably dimensioning the flexible connecting member. The first harmonic would almost coincide with the first-order vibration of the free crankshaft and would therefore be twice the frequency of first-order vibration of present crank assemblies with the propeller rigidly mounted. Torsional vibration moments originating in the crankshaft could not be transmitted in any degree to the propeller, and there would be no longer any propeller vibration due to torsion. The crankshaft-propeller system therefore would be to a large degree free from vibration within the operating speed range.

Adoption of such flexible driving members would have very favorable results. Crankshaft dimensions could be decreased and could be based on the mean driving torque. The weight thus saved could be put into counterweights

(Turn to page 917, please)

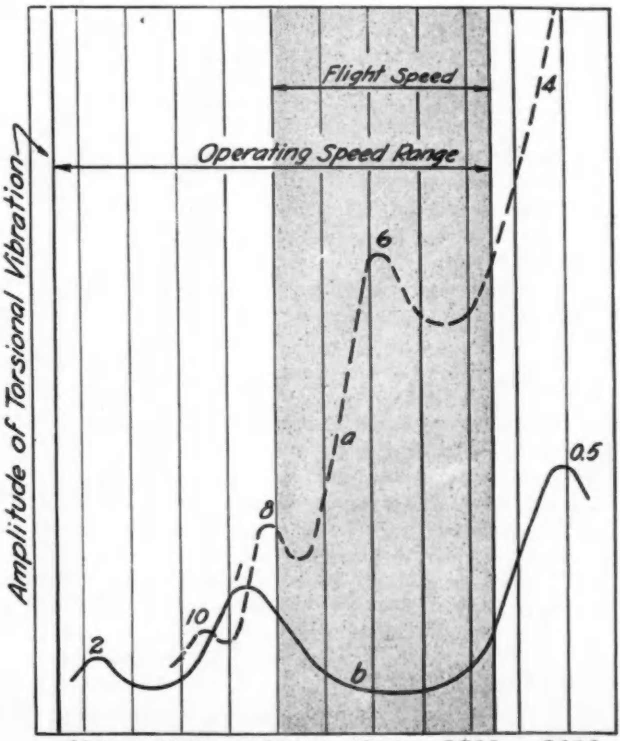


Fig. 3—Amplitudes of torsional vibration vs. crankshaft speed for a four-cylinder engine with rigidly mounted propeller (dashed) and flexibly-driven propeller (full line) (The figures on the curves represent the harmonics of the gas-pressure torque with which the assembly is in resonance)

PRODUCTION LINES

Accurate temperature control for pistons at the moment they are checked for size by sensitive electric gages, is the purpose of the latest precision device developed by the Plymouth Division of the Chrysler Corp. The new piston cooling tunnels shown above prevent even slight variations in size which might be caused by change in room temperature, and bring every piston to the gages at exactly 78 degrees, Fahr.

Convention Papers

This year's Summer Meeting convinces us that the SAE National Meetings Committee should definitely hold down to two papers per session, and on occasion to only one. At this meeting the latter occasion could have been the aircraft session, devoting the whole evening to the paper by H. Wood of Rolls-Royce. More than two papers per session can be handled, but it requires much advance preparation and hard-hearted technique barely worth the candle.

Body Chair

George Mercer proposed an interesting idea at the Summer Meeting. Let's get together and sponsor a chair in body engineering in Class 1 universities so as to give this important branch of automotive engineering its due. It may be a mighty smart move for some institution to give the suggestion a try.

Remote Control

We have it on good authority that the principle of remote control of gear shifting, the first instance of which was on the Hudson and Terraplane lines, is spreading widely. Probably a number of 1937 cars may feature remote control. And its use has been extended to watercraft.

Building Bigger

Ted Gamble, Borg & Beck manager, told us recently that current orders already have overstressed plant capacity. How they feel about future business prospects may be gaged from the fact that the company is now in the process of expansion and buying a goodly amount of new production equipment.

More Comfort

An important part maker is studying the design of an air-conditioning unit for passenger cars. It's a compact attachment not much larger than a good-sized water heater, arranged for cooling in warm weather and heating in cold seasons. Price is no more than that of a radio set. Wouldn't you go for it?—that's what we told them.

Finders, Keepers

This may no longer be news, but we insist upon mentioning it. That song hit, "Lost," the hit-of-the-week three times in a row and then back in first place again, was written by Macy Teetor of the Perfect Circle Teetors. And is Hagerstown proud! What a far cry from the inside of a cylinder to the top of Broadway and Main Street.

Crush Pins

You may not know it, but Yale & Towne has been making an autobody lock with crush pin construction that's just the thing for mass production. Every part of the lock is now interchangeable. They can ship them in big lots and you can install them any time, anywhere. The business of shipping, storing, and fitting locks in sets is definitely a thing of the past.

Air Sized

A recent European development in hair-splitting measurement may soon be available here. The device is a pneumatically-operated inspection gage designed for use in routine production checking. It is claimed to give readings far closer than modern manufacturing demands and is by no means high in first cost.

Gear Broach

One of the transmission builders is working out a method of push-broaching internal helical gears in a fairly large ring. When ready this should be one of the most interesting applications of surface broaching known to the industry.

Father-Son

Warner Gear Co. started a rather interesting experiment recently by way of improving the apprentice situation. Instead of scouting around for recruits, they made a canvass of every employee who had a son or sons old enough to work. Out of this came a large group of boys who were placed immediately. The second generation is mighty fine seed as loyal and intelligent employees of a home industry.

DuPrene Sandwich

Western Felt is offering a rather unusual washer which may take your fancy. It consists of a sandwich of two discs of felt, either of the same quality and thickness or entirely different, with a duPrene synthetic rubber disc in between. The rubber center dams up the oil and keeps it from seeping through. Can you use it?

J. G.

MANUFACTURING
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Propeller Vibration

(Continued from page 915)

for the crankshaft, and these counterweights also should not be rigidly secured to the crank arms, but flexibly mounted, so as not to reduce the natural frequency of torsional vibration of the crankshaft. It would not be necessary to use quite as expensive material for the crankshaft as at present.

The development of a suitable flexible joint between crankshaft and propeller hub is primarily a problem of design and choice of proper materials. Aside from the familiar metal springs, a combination of metal with rubber, the former vulcanized to the latter, seems to offer the greatest promise. Research work on such a driving joint is at present in progress at the German Institution for Aeronautical Research.

Where reduction gearing is used the flexible element can be most readily introduced into the gears (Fiat A 30), while in direct-drive installations it can be most easily placed in the propeller hub (Carter hub). The flexible joint should be designed in advance to suit the vibration characteristics of the driving system, and should be developed along with it. Application of a flexible drive after the installation is completed will always involve great difficulties.

Vibration characteristics of a four-cylinder engine with rigidly mounted propeller and with a flexible-driven propeller, respectively, are shown in Fig. 3. The flexible hub is provided with torque arms and tubes for torsional cushioning. This hub, with suitable torque arms, may also be used as an instrument for determining torsional moments.

Heat Rejection in Diesels

AN investigation on heat rejection in Diesel engines has been started by Myron S. Huckle, consulting engineer, and Harold V. Nutt, both of whom are connected with the U. S. Diesel Engineering School of Boston. In a paper by these authors a sort of preliminary report on this investigation was made to members of the S.A.E. at their summer meeting. The object of the investigation is to determine the effects of the following factors on the amount of heat rejected to the cooling water:

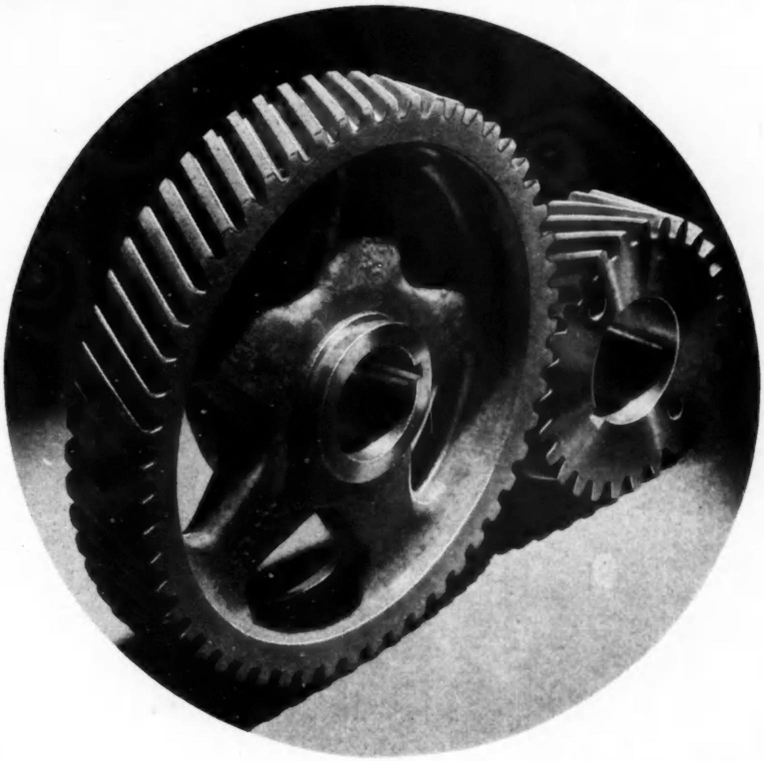
1. Spark ignition vs. compression ignition.
2. Exhaust-manifold and lubricating-oil cooling.
3. Load.
4. Injection timing.
5. Engine speed.
6. Type of engine.

In the paper the apparatus and the test procedure were described and the results were given in a set of curve sheets. It was found that in the Diesel engine the rate of heat flow to the jacket water increases more rapidly with load than in a carburetor engine. This, of course, is in accordance with the fact that the brake thermal efficiency of the Diesel engine does not fall off as rapidly as that of a carburetor engine with decrease of load. Generally speaking, the rate of heat rejection to the jacket water per cu. in. of displacement is less in a Diesel than in a carburetor engine, although the speed of operation is a factor in this connection. It was found that the rate of heat rejection to the jacket water is much greater in a turbulent than in a quiescent engine.

Detonation and Oil Consumption

TESTS made at the Pennsylvania State College, in the course of a cooperative research program carried out jointly with the Pennsylvania Grade Crude Oil Association, it was found that the oil consumption of an

Celoron "Spoke" Timing Gears



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engine increases materially when there is detonation. This was brought out in a paper, at the S.A.E. Summer Meeting, on "The Effect of Detonation on Oil Consumption" by H. A. Everett and J. J. Mikita. In the tests the engine developed 51 hp. at 3250 r.p.m., and ran on a mixture having an air/fuel ratio of 14/1; the oil was circulated at the rate of 19.5 cu. ft. per hour and was maintained at a temperature of 230 deg. The outlet temperature of the cooling water was 160 deg. F.

In one test, advancing the spark from 28 deg. B.T.C. to 37 deg. B.T.C. (where detonation occurred) increased the oil consumption approximately 25 per cent Upon retarding the spark to 28 deg. B.T.C. detonation apparently ceased, there being no audible knock, but the rate of oil consumption did not return to that of the first test, but rather increased slightly.

In the fourth test, advancing the spark to 37 deg. B.T.C. again caused audible detonation, but no further increase in oil consumption. At the end of the fourth test, the engine was shut down and allowed to stand for 24 hrs. and then started again. With the original spark advance, 28 deg., its rate of oil consumption returned to normal, about 0.79 lb. per hour. The continuance of the high oil consumption in test 3, after the detonation had stopped, which was also observed in later, similar tests, remains to be explained. The effect is apparently nullified by shutting down the engine and allowing it to cool.

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The Forum

(Continued from page 905)

fecting economies that make their cars less safe. Just note how many are using four-ply tires instead of six-ply, a fundamentally wrong move in this day of high speed.

And you consider the reference to bumpers as silly. I do not. I saw a splendid example of this recently. A recent model of a well-known car made in large quantities had front and rear bumpers which afforded the owner no protection whatsoever when at a stop-light a car from behind hit another hard enough to push it into the car ahead. The front bumper, due to artistic design, was no protection and resulted in a smashed radiator grille. The rear bumper was of soft steel, not reinforced, resulting in a disfigured bumper and a badly dented body.

The manufacturer can do much to help and it is exceedingly unfortunate that you take the stand you do.

Yours truly,
L. L. CASS.

The Horizons of Business

(Continued from page 903)

theory to corporations is ludicrous unless there is an ulterior design. For a small corporation subject to an 8 per cent normal tax may be owned by a single wealthy individual whereas the big corporation may be owned by 100,000 stockholders, a large fraction of whom may have incomes of less than $5,000 a year. Thus the progressive tax upon corporations loses sight entirely of the just reason underlying the graduated tax theory.

Two separate progressions are applied in the new tax bill. In the first the rate of tax varies with the amount of the earnings. Since the revenue and simplification motives of the bill are secondary the object of this progression is to penalize the size and success of corporate enterprise. The second progression varies the rate directly with the amount of earnings *retained* by the corporation. This is directed against corporate thrift and foresight and penalizes companies which make provision for growth and the unknown hazards of the future.

AUTOMOTIVE INDUSTRIES

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